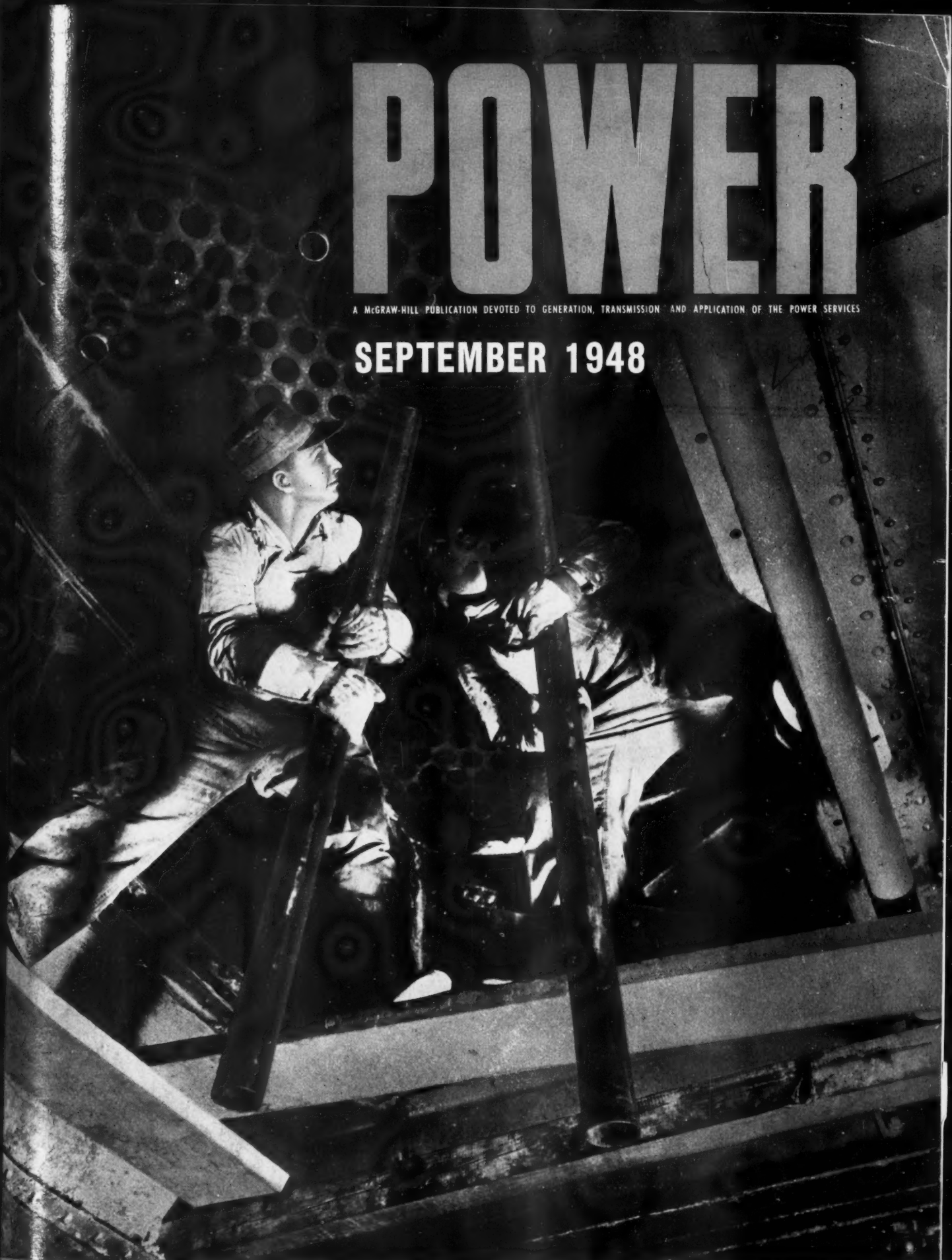
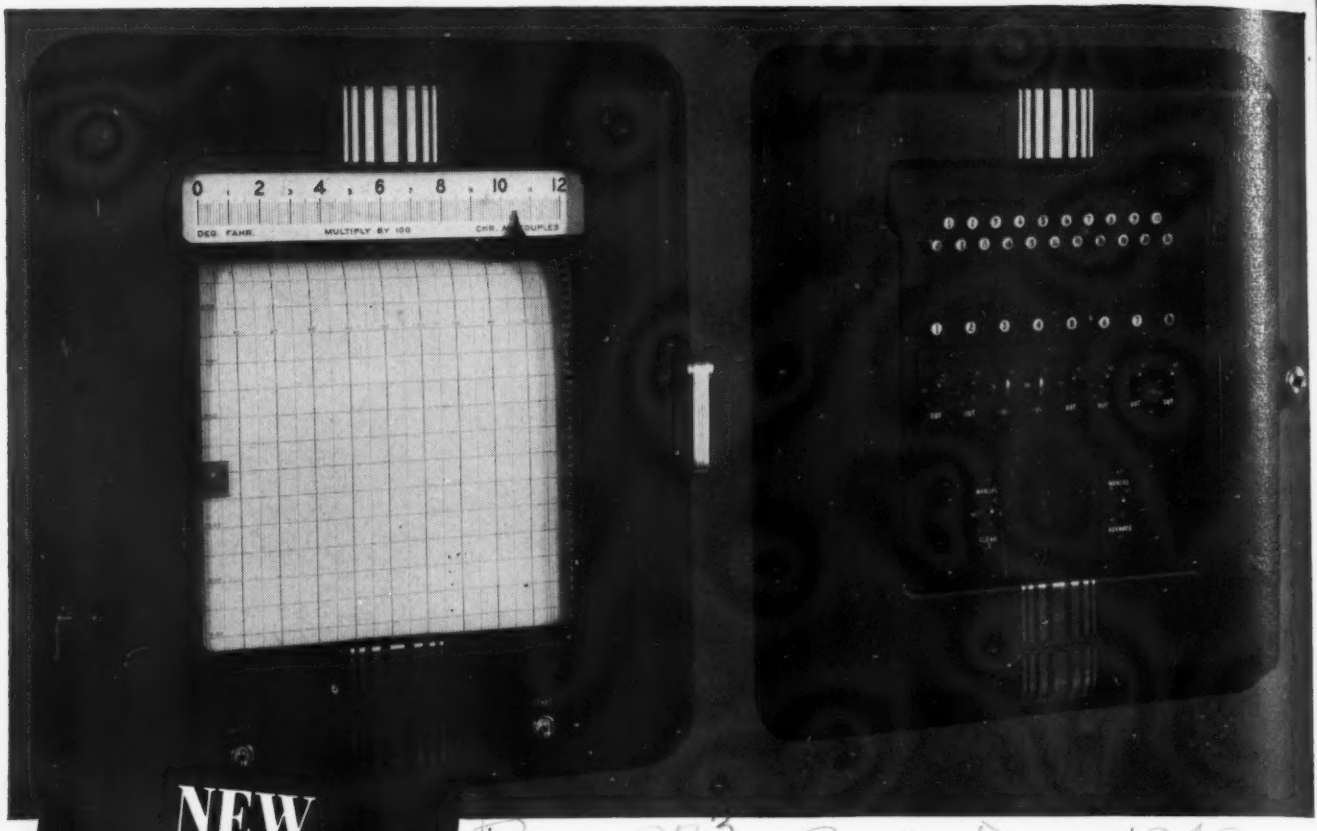
POWER

A McGRAW-HILL PUBLICATION DEVOTED TO GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

SEPTEMBER 1948



IN THIS ISSUE: First gas turbine for a U. S. utility to go into existing steam plant; 3500-kw unit to boost output 6000 kw, improve heat rate — for exclusive design story, see p 64; New method shows how to get best performance from hydro-pneumatic tanks, p 75; Simplified presentation makes crystal-clear how controls work, p 82; Internal conditions of old boilers guide water-treatment program for new ones, p 88. **CONTENTS, p 59**



NEW PROTECTOR FOR BOILERS

Checks 160 Tube Temperatures In Only 10.6 Minutes!

Remarkably fast, this new Speedomax equipment offers a definite advance in protection for large boilers. With it, the shift operator can "tour" the temperatures of 160 tubes in a little less than eleven minutes. He can stand and watch the readings as they are automatically indicated; or Speedomax will record them for later examination and for the shift log.

In either case, readings are supplied in such rapid rotation that it is generally possible to determine the exact point at which any high or low temperature first develops, even though the condition may later spread to other points. This speed thus helps both to detect and to isolate trouble.

The installation procedure is familiar to most power engineers. The power company's staff simply makes up thermocouples and attaches them to the tubes which they decide will give the most useful temperature readings. Conventional-type couples, at points outside the gas passages, are of course usually included in the installation. Couples are connected to the Speedomax equipment in 8 banks of 20 each, and appropriate alarms are included.

Records When Desired

The Speedomax automatically measures these temperatures at a rate of one every 4 seconds. Signal lights wink on for each couple, and as long as temperature remains correct the instrument merely indicates . . . does not record. It can be made to record at any time, however, by merely throwing a switch. Or if any temperature reaches its predetermined limit, an alarm sounds and the Speedomax automatically records until switched off. Also, any bank or banks of couples can be switched out at any time, thus concentrating on areas of special interest.

For further information about these equipments, please write Leeds & Northrup Co., 4910 Stenton Avenue, Philadelphia 44, Pa.

Substantially The Same Equipment Can Be Used For Turbine and Generator-Bearing Temperatures

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

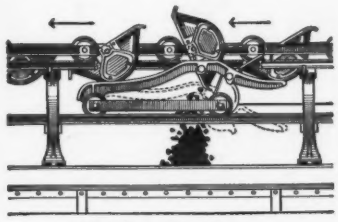
LEEDS & NORTHRUP CO.

Jrl. Ad N-33A-463(3)

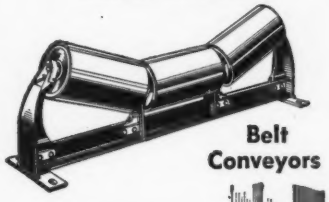
POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer" and "The Stationary Engineer", September, 1948, Vol. 92, No. 9. Published monthly with an additional Directory number in June. McGraw-Hill Publishing Company, Inc. Publication office, 99-129 North Broadway, Albany, N. Y. Editorial and executive offices, 330 West 42nd Street, New York 18, N. Y. Entered as second class matter August 25, 1936, at Albany, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least ten days for change of address. Subscription rates—U. S. and U. S. Possessions $5 for one year, $8 for two years, 50c per copy. Canada $6 for one year, $9 for two years. Pan American Countries, $10 for one year, $16 for two years. All other countries $15 for one year, $25 for two year. Please indicate position and company connection on all subscription orders.

LINK-BELT EQUIPMENT

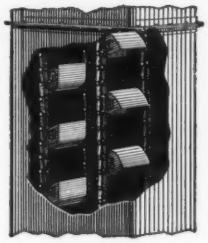
Meets Every Need of Industry in Handling Coal and Ashes



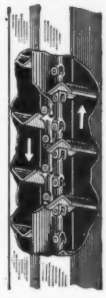
Bucket Carriers



Belt Conveyors



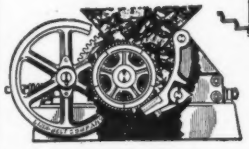
Bucket Elevators



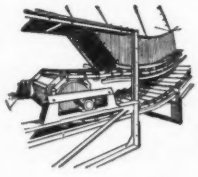
Bulk-Flo

Screw Conveyor

Skip Hoist

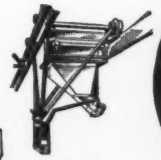


Coal Crusher

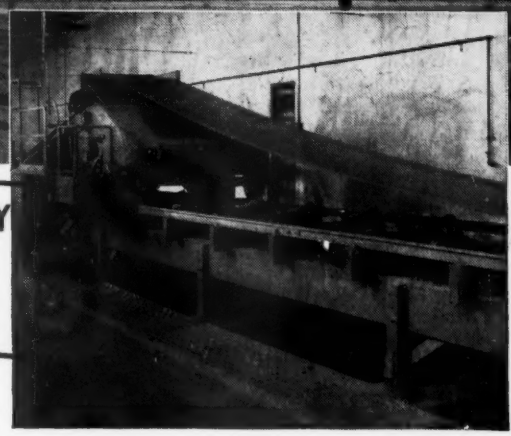


Feeders

Car Dumper



Weigh Larry



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DETROIT

Versatile Coal System Handles 450 T.P.H. of Bituminous Slack

This coal handling system is very versatile in that it is arranged to receive coal by river barge or railroad car and convey it to either the boilerhouse bunker or reserve ground-storage, at the rate of 450 tons per hour, as well as handle coal from reserve storage to bunker when necessary. A tank type self-propelled and self-reversing belt tripper operates to distribute the coal inside the plant.

Completely engineered by Link-Belt, the belt conveyor system includes six 36 in. wide units of varying lengths, with three feeder conveyors under receiving hoppers. Link-Belt self-aligning troughing idlers are used at intervals, and Link-Belt differential band brakes are used to prevent backward motion of loaded inclined conveyors in case of power failure.

We'll be glad to give you complete details of this and other power plant coal handling systems. Get in touch with our nearest office.

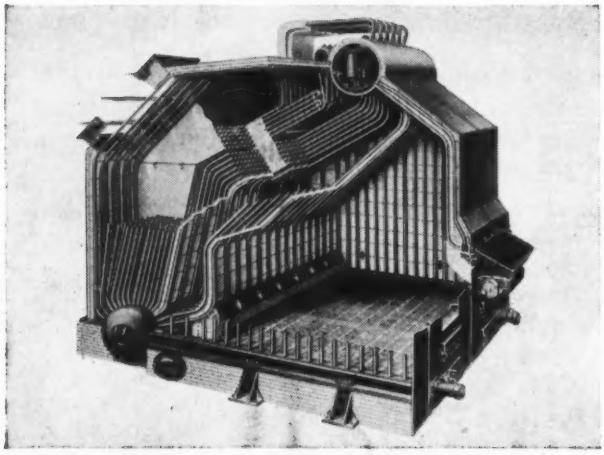
LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.

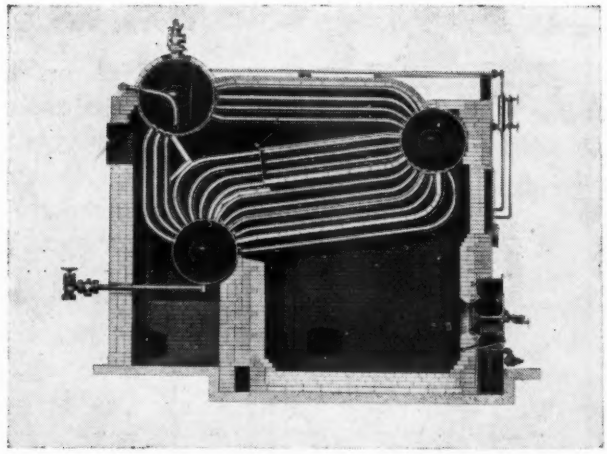
11,163

LINK BELT

COAL AND ASHES HANDLING EQUIPMENT



B&W Integral-Furnace Boiler, Type FF with completely water-cooled furnace, for high duty power and process services.



Type H Stirling Boiler usually for low-headroom installations where oil-refractory furnaces are suitable; water cooling may be added.

ALL are fully coordinated, flexible units—from fuel burning equipment to breechings and stacks—built and installed under undivided responsibility.

ALL are time-tested, performance-proved units of simplified design and standardized manufacture.

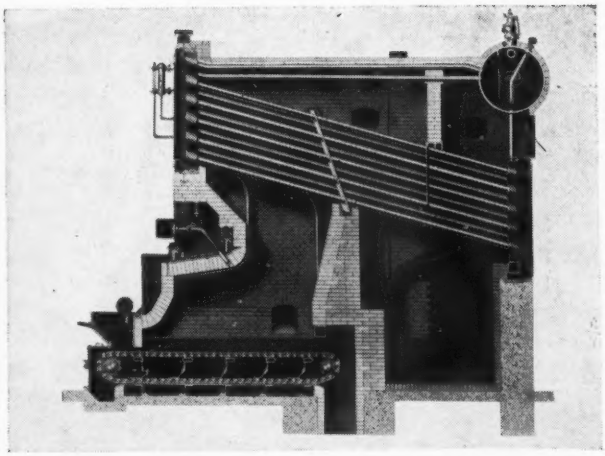
ALL fully meet modern requirements as to fuel flexibility, compactness, ease of operation, fast-steaming and ability to take sudden load swings.

ALL sustain high operating efficiency over their wide range of output, and generate steam of satisfactory quality at all ratings.

ALL have provision for adding superheaters.

Industry-wide demand for Type FF Integral-Furnace, Type H Stirling and B&W Design 32 Boilers continues at an impressive rate. Units of these three complete, compact designs ordered in the first seven months of 1948 steam capacity of over 5,000,000 lb. per hr. for power, heating and process requirements in a wide variety of industrial, commercial and utility plants in this country and abroad.

What makes B&W CUBS* so attractive for steam requirements up to 60,000 lb. per hr. at pressures above 160F? *All three* types fully satisfy modern demands for complete, compact, coordinated boiler units, yet each has distinctive features that make it preferable for specific service conditions. *All three* offer time-tested, cost-saving installation, operating and maintenance advantages. And *all three* have long impressive records for giving the long-term reliable and economical service so essential to low-cost steam generation.



B&W Design 32 Boiler for low-headroom installations where simplicity of straight-tube type is desired.

ALL embody design, construction and operating features that account for the heavy preference for larger B&W boilers for central stations and large industrial applications.

***Complete Unit BoilerS**

Each as much a package boiler as *any* unit its capacity can be.

BABCOCK & WILCOX

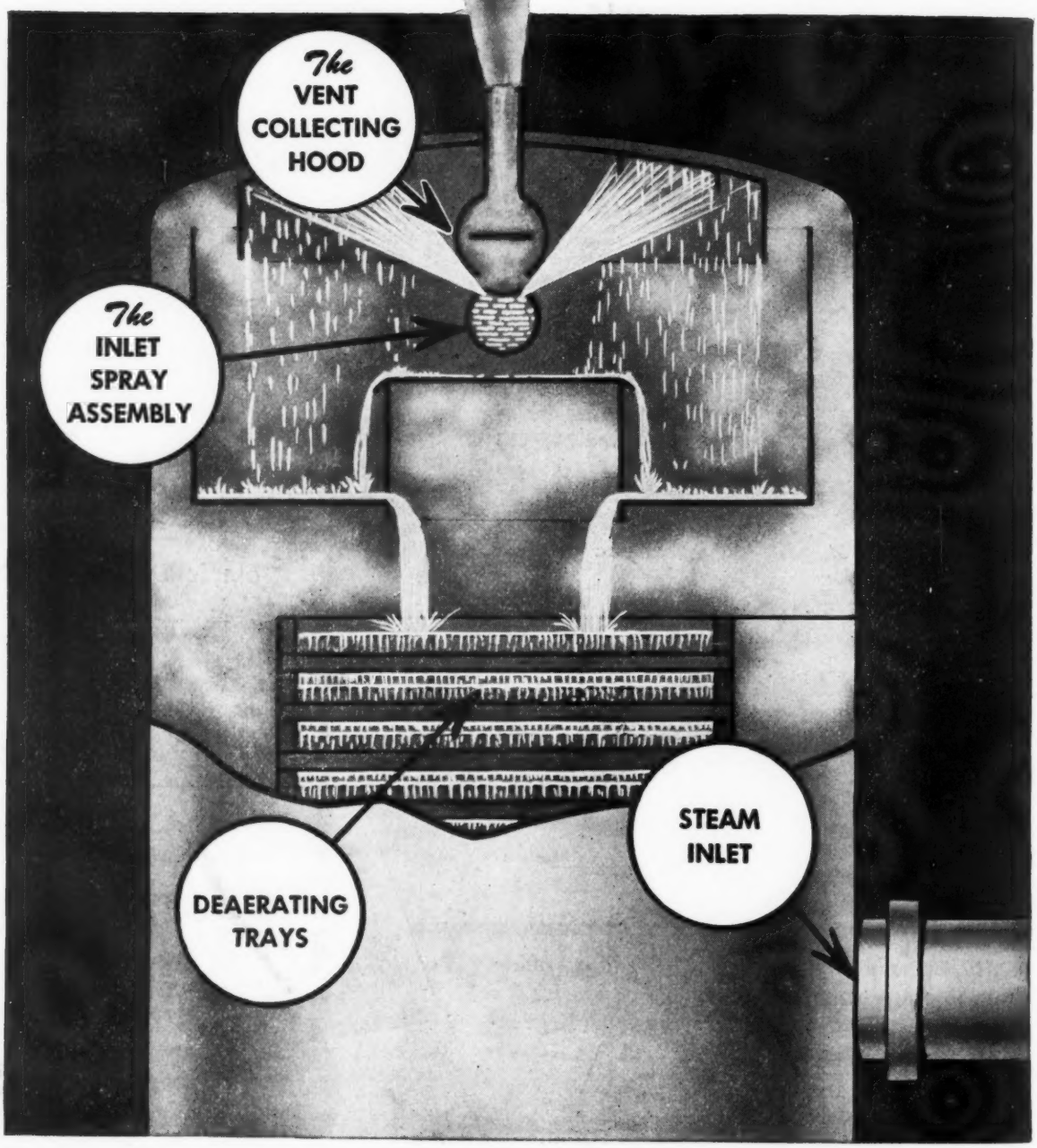
THE BABCOCK & WILCOX CO.
GENERAL OFFICES: 85 LIBERTY ST., NEW YORK 6, N.Y.
WORKS: ALLIANCE AND BARBERTON, O.; AUGUSTA, GA.

G-407

FOR POWER PLANTS—B&W, Open-Pass, Radiant, Integral-Furnace, Cross-Drum, Stirling and Waste-Heat Stationary Boilers . . . Air Heaters . . . Economizers . . . Superheaters . . . Water-Cooled Furnaces . . . Oil, Gas & Multifuel Burners . . . Chain-Grate Stokers . . . Stacks and Breechings . . . Seamless & Welded Tubes for All Pressure and Mechanical Applications . . . Refractories . . . Chemical Recovery Units . . . Alloy Castings. OTHER B&W PRODUCTS—Marine Boilers . . . Pressure Vessels . . . Process Equipment.

THE *new* Elliott

EXIT CORROSIVE



ELLIOTT COMPANY PLANTS AT: JEANNETTE, PA.

SPRAY-TRAY DEAERATING HEATER

E GASES

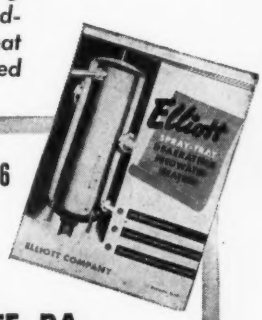
with no tubular vent condenser, no corrosion of parts, no maintenance.

The operation of the new Elliott deaerating heater is simple. The incoming water, agitated and broken into sheets and droplets, falls through the steam flow rising to the top of the unit. Most of the heating occurs in the upper section, so that as the water reaches and passes through the deaerating trays it readily gives up its oxygen and other noncondensable gases, which are swept upward by the steam to the vent collecting hood. At this point the steam is condensed by the incoming water, while the noncondensable gases are forced out the vent.

The big advance in the new design is the elimination of the tubular vent condenser, which has been a main cause of maintenance. Headroom is lowered too, and some piping is eliminated. Furthermore, stainless steel is used in the vent collecting hood, baffles and trays. No undeaerated water contacts the steel shell.

With this unit Elliott engineering hits a new high in deaeration operating economies.

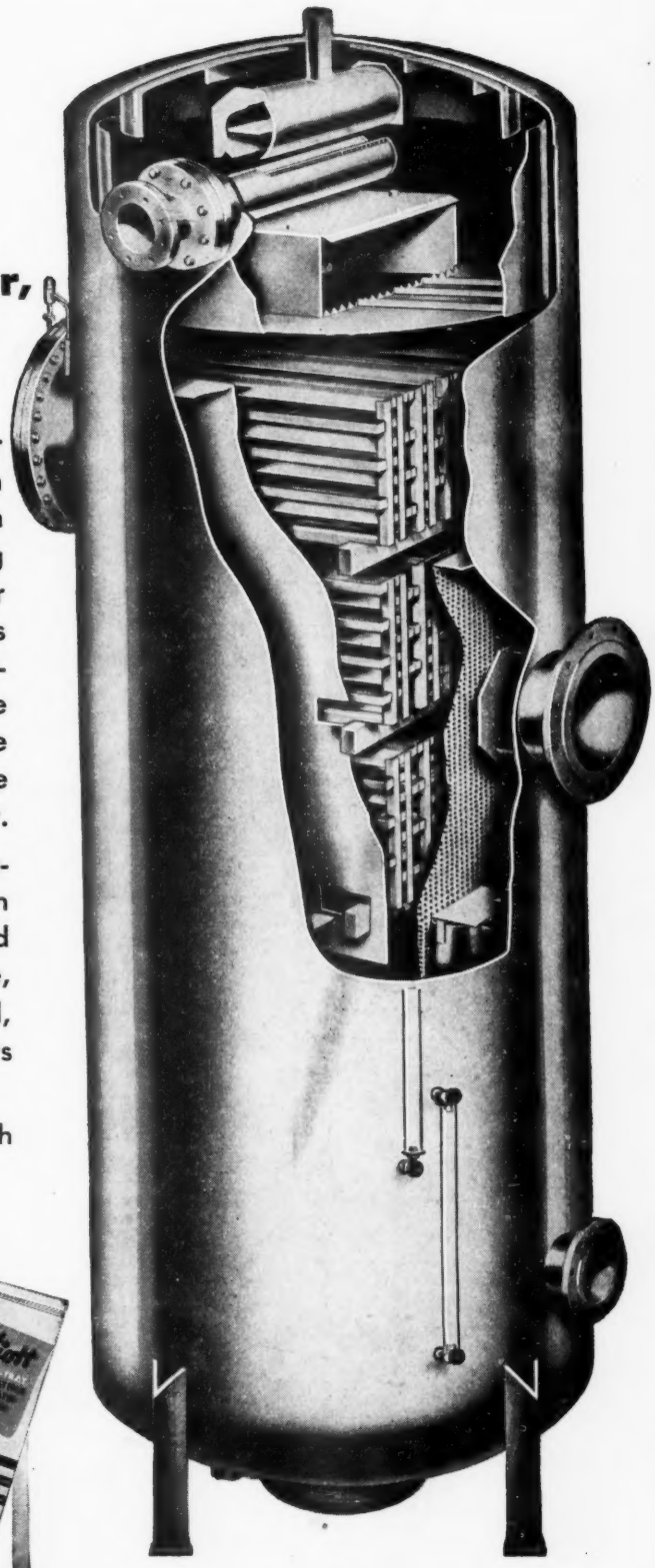
Besides the protection of deaeration, deaerating heaters are a good investment from the standpoint of efficient feedwater heating. They heat the water up to the temperature of the saturated steam supplied to the heater.



For Complete Details, Write for Bulletin PN-16

Address:

TECHNICAL DATA DEPT.
ELLIOTT COMPANY, JEANNETTE, PA.



N-993

RIDGWAY, PA. • SPRINGFIELD, O. • NEWARK, N. J. DISTRICT OFFICES IN PRINCIPAL CITIES

see exactly what is happening beyond range of vision . . . around corners . . . through walls

The Diamond "Utiliscope" uses television to provide a clear, exact picture of something currently taking place at a remote or inaccessible point.

For example, in the Hell Gate Station of Consolidated Edison, New York City, it brings to the control room the instantaneous and unmistakable image of the water level in a boiler water gauge that is 8 floors above and 325 feet away in another building.

A continuous picture is produced by 60 individual image fields each second (sound motion pictures have only 48 per second). Every change in whatever is viewed is reproduced faithfully and instantly . . . there is no measurable time lag.

Construction is simple and rugged . . . the Diamond "Utiliscope" has fewer tubes than a good radio set and is built for continuous operation at temperatures up to 150° F. Installation requires no special skill; instructions can be followed by anyone using ordinary care.

Exceptional stability is another important characteristic of the "Utiliscope". This permits simplification of control to the point where only a screw driver is needed for adjustment of focus, brilliance and contrast to suit individual preference.

If you must see *exactly* and *instantly* something that is happening beyond the range of vision, around corners and through walls . . . or that is perilous to human life to observe directly . . . the "Utiliscope" is probably the answer to your problem. Ask for Bulletin No. 1013.

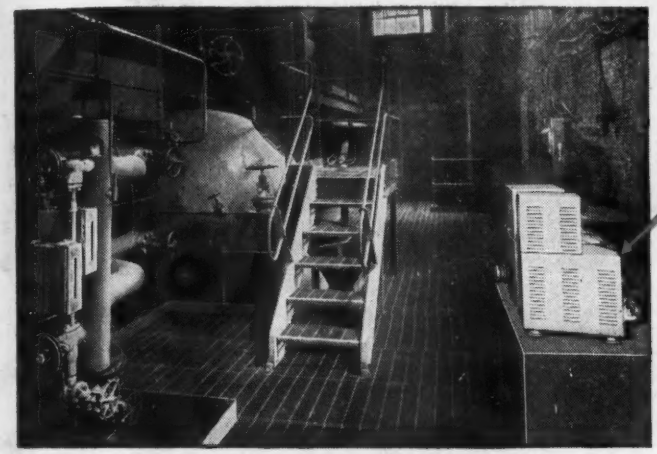
For exactly, simultaneously and continuously picturing at a remote point . . . an object, operation or condition

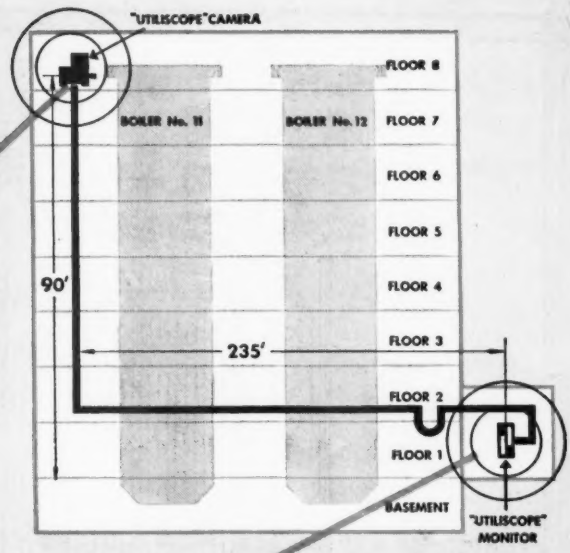
The "Utiliscope" was developed jointly by the Farnsworth Television & Radio Corporation and the Diamond Power Specialty Corporation.

DIAMOND POWER SPECIALTY CORP. • Detroit 31, Mich.

with the DIAMOND "UTILISCOPE"

(TELEVISION IN INDUSTRY)





(Above) "Utiliscope" camera scans water level gauge of Boiler No. 11 at Hell Gate Station of Consolidated Edison in New York City. Eight floors below and 325 feet distant, the "Utiliscope" monitor (viewer) is mounted in the instrument panel in the control room. Small changes in water level are immediately apparent to the operators at all times.

OTHER USES

To observe radioactive materials behind barriers.

To reproduce images of maps, charts, etc.

To observe coal feed to pulverizers or stokers.

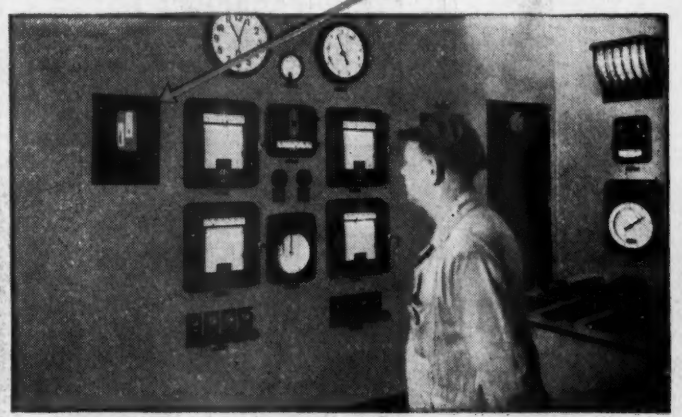
To observe burner ignition, secondary combustion, slag flow, etc.

To observe presence of smoke from stacks.

To reproduce readings of electric meters, liquid level or temperature gauges, etc. located at remote or inaccessible places.

To observe conditions in steel furnaces.

"Utiliscope"—Registered U. S. Patent Office

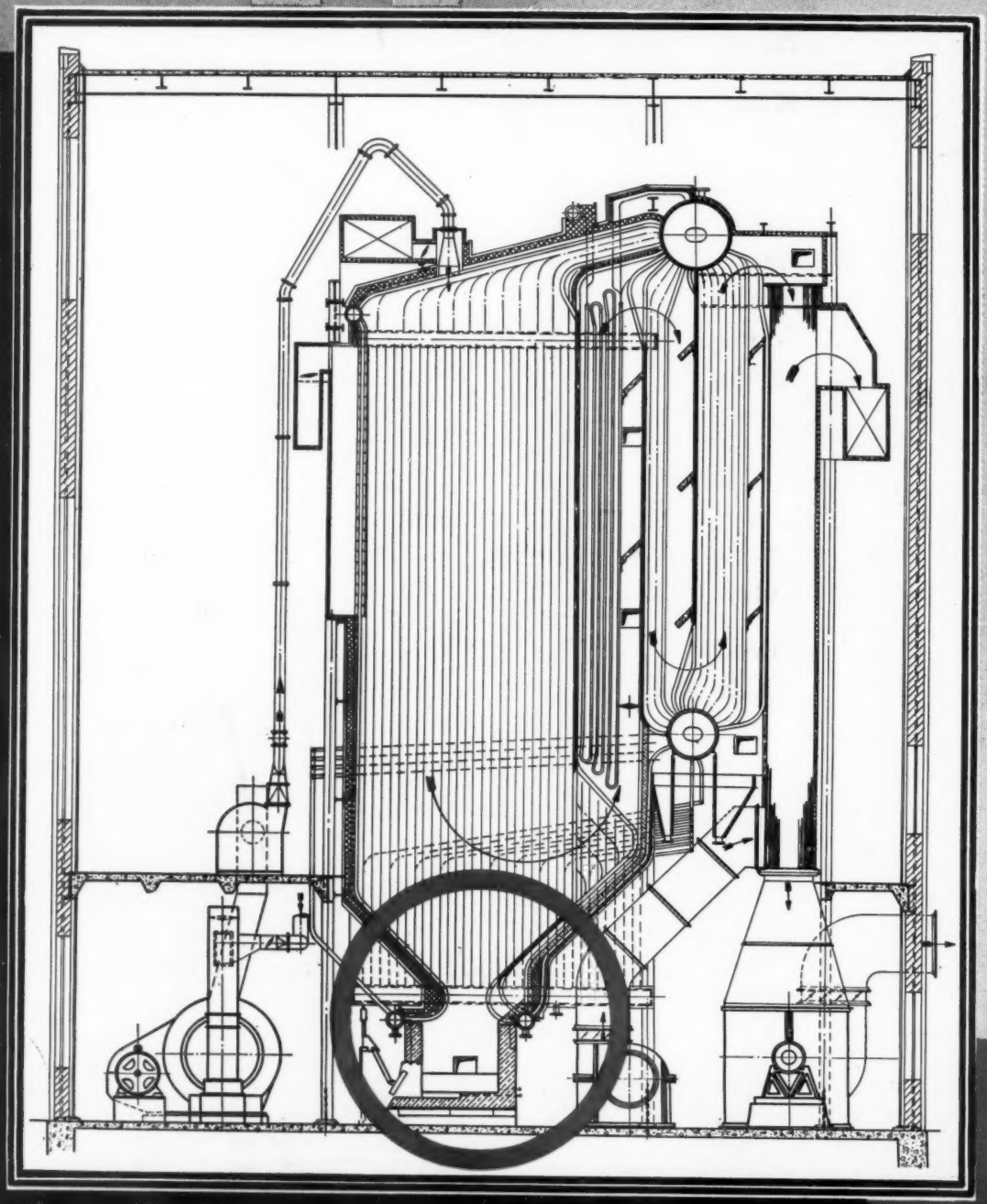


WRITE FOR BULLETIN No. 1013

This bulletin illustrates the Diamond "Utiliscope" and describes its operation in detail. A copy is yours for the asking.

DIAMOND SPECIALTY LIMITED · Windsor, Ontario

ENGINEERING of . . . . .



KVS PRODUCTS

Boilers . . .

Air Swept Tube Mill Pulverizers . . .

Fans . . .

Preheaters . . .

Superheaters . . .

Economizers . . .

Water Walls . . .

Coal Elevators . . .

Bunkers . . .

Ash Conveyors . . .

DRY BOTTOM FURNACES

Increases radiant surface—Contributes to maximum economy with available fuels—Reduces hopper maintenance . . .

Tubes forming the dry bottom furnace are a part of the furnace wall enclosure and originate in headers so arranged that water supply is distributed throughout their entire length. The throat formed by these tubes is designed to protect the ash collecting hopper and is sealed against air infiltration.

Ash formed by combustion is deposited on the sloping portion and finally deposited in the refractory lined hopper below.

Designed to accommodate the lower heat value, high ash content fuels, KVS Dry Bottom Furnaces assure long operating periods without refractory maintenance.

We have not featured KVS Air Swept Tube Mills with automatic controls here, because we believe the industry recognizes their superiority.

All other components of KVS Steam Generating Units are engineered to meet specific operating conditions on available fuels in order to assure the maximum in operating efficiency and economy at all boiler ratings.

KVS ENGINEERING SERVICE

KVS Steam Generating Equipment has been performance-proved over the years. KVS offers a complete service in design, building and erecting complete plants under one responsibility. KVS engineers are available for consultation on your requirements.

Ask for a copy of 97-page Engineering Bulletin No. 44-B containing valuable information on preparation of pulverized fuel and steam generating plants.

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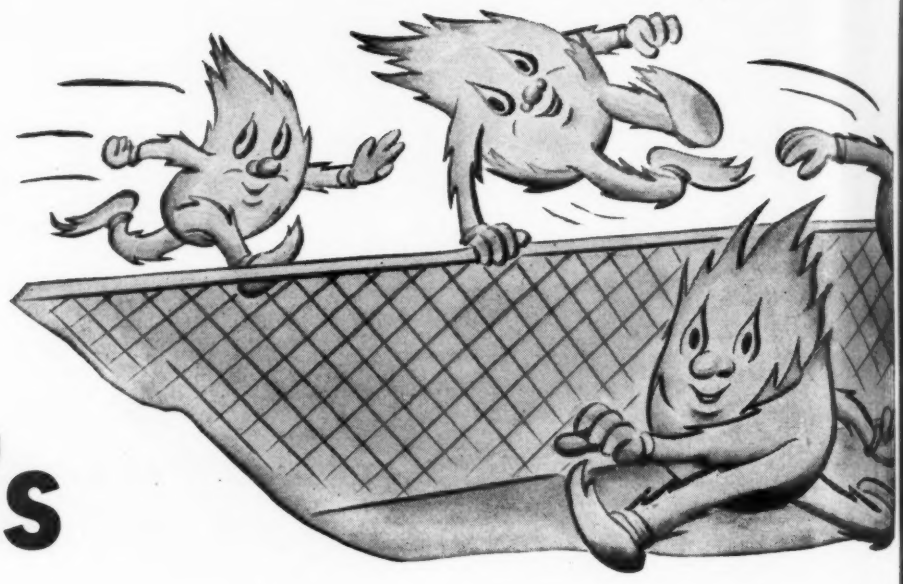


Btu's

Every fuel has a large percentage of Btu's ready to "go over the fence". They do no work. They produce no power. The more you can keep on the job—the lower your power costs will be. And that is exactly what the Bailey co-ordinated boiler control system can do for you.

It reduces fuel consumption per pound of steam generated. Combustion, feed water, steam temperature, heater levels, pump speeds and all other factors are co-ordinated—automatically controlled. With Bailey Controls safety of operation is increased—continuity of service is improved. You convert the maximum number of Btu's into power. You get full efficiency from your boiler.

Many Bailey co-ordinated boiler control systems have paid for themselves in fuel saved in less than one year. All do not return their original cost as quickly as this. But the quick way to find out how Bailey boiler control will work for you is to talk to one of our engineers. Bailey co-ordinated boiler control is not a package unit. Each must be engineered to the specific job.

If you are looking for low cost power, it will pay you to call our nearest office.

A-105-1

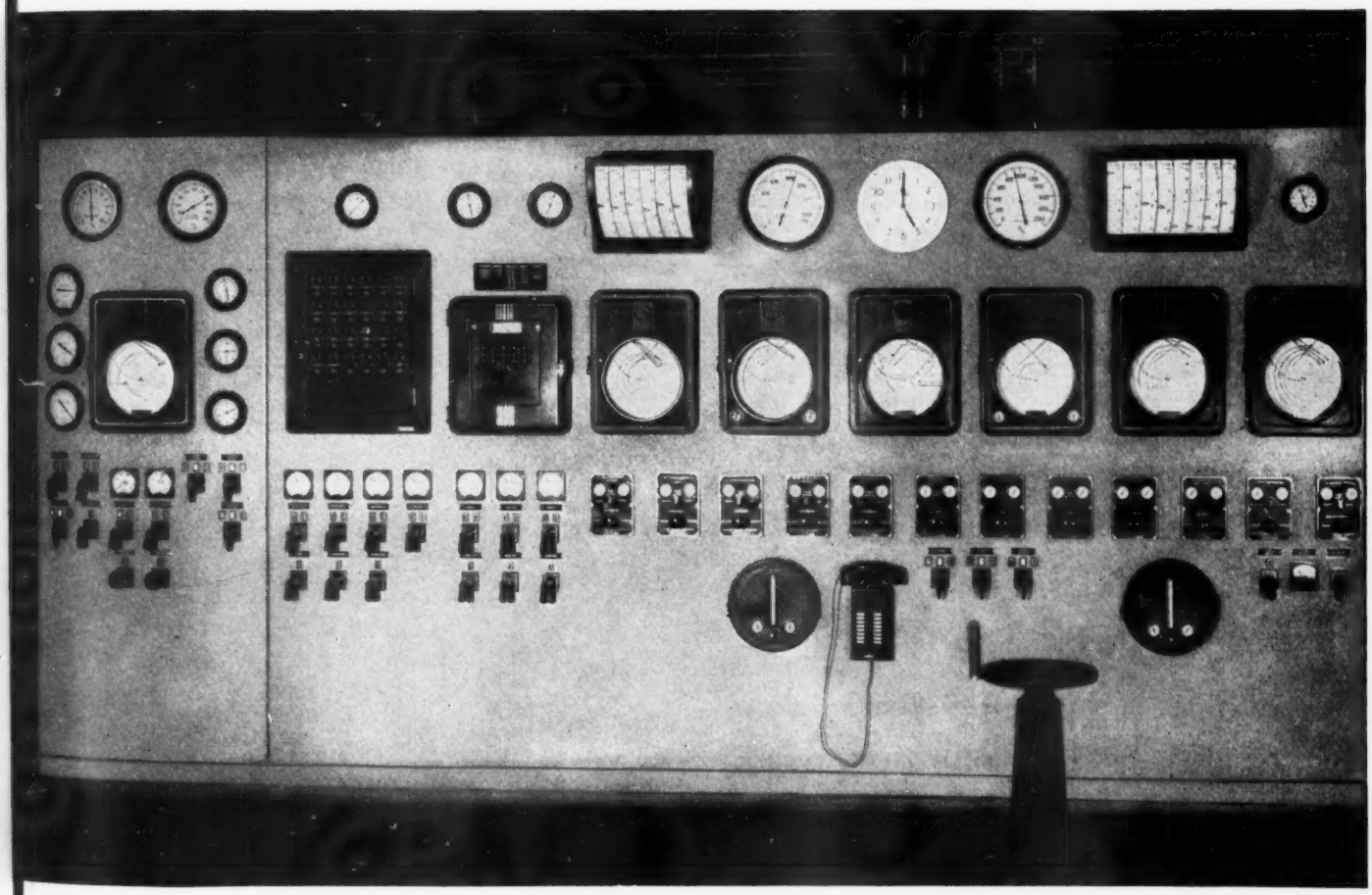
BAILEY METER COMPANY
1036 IVANHOE ROAD • CLEVELAND 10, OHIO
BAILEY METER COMPANY LIMITED, MONTREAL, CANADA

Controls for Steam Plants

COMBUSTION • FEED WATER • TEMPERATURE
PRESSURE • LIQUID LEVEL • FEED PUMPS

Branches in: Boston, New York, Schenectady, Philadelphia, Buffalo, Pittsburgh, Charlotte, Cleveland, Detroit, Cincinnati, Atlanta;

Go a.w.o.l.



This co-ordinated system of Bailey Combustion and Three-element Feed Water Control prevents Btu's from going a.w.o.l. at Potomac Edison Company, Williamsport, Maryland. The maximum steaming capacity of this 860 psi pulverized coal fired boiler is 400,000 lbs. per hour.

Chicago, Milwaukee, St. Louis, New Orleans, St. Paul, Kansas City, Houston, Denver, Los Angeles, Seattle, San Francisco

NOW... FLEXIBILITY IN AT NO EXTRA

Here's good news! The new Type DP turbine affords a 30% range of speed adjustment. Best of all, hydraulic governing—the design feature which makes this possible—is standardized on this standard turbine . . . costs you no more.

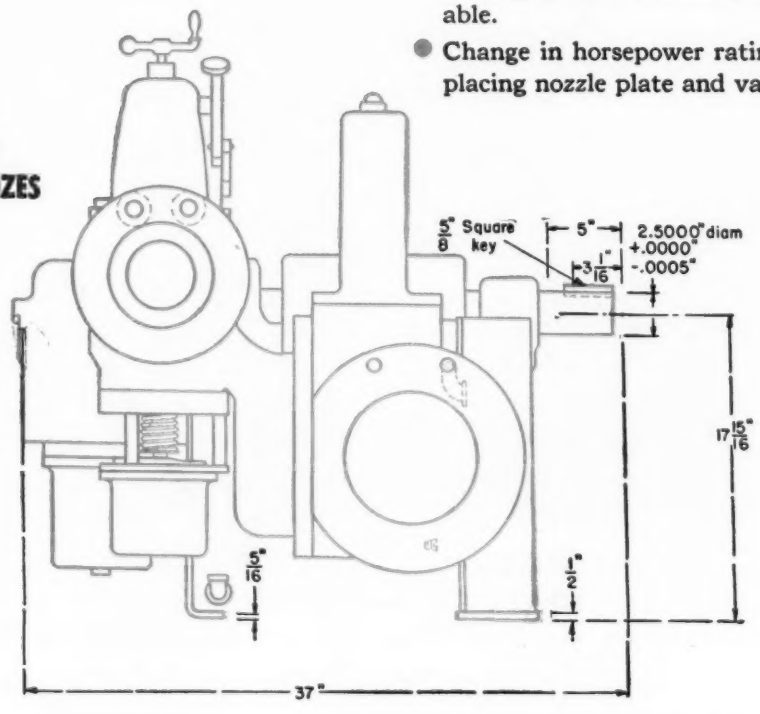
This wide speed range is two or three times greater than that obtainable with previous mechanical governors. Likewise, the accuracy of governing is greater. Speed regulation is approximately 6%. This greater flexibility in performance permits you to meet many more of your turbine applications with standards—rather than costlier "specials."

FLEXIBILITY IN APPLICATION

When your plant requirements change and turbine drives must be re-located, you'll find that Type DP standard turbines save you time and money. Designers of the Type DP line have carried interchangeability to a new high. Here's how that makes moving easier . . .

- Mounting height is standard—the shaft-to-floor dimension is the same on all frame sizes.
- Couplings can be standard—all DP shafts are identical.
- Alignment is simple—center-line supported turbines do not change alignment with casing heating.
- Change in speed requirement (beyond handwheel adjustment) can be met by replacing small pump drive gears. Nine standard gear ratios are available.
- Change in horsepower rating can be made by replacing nozzle plate and valve parts.

DIMENSIONS COMMON TO ALL FRAME SIZES



TURBINE OPERATION

COST!

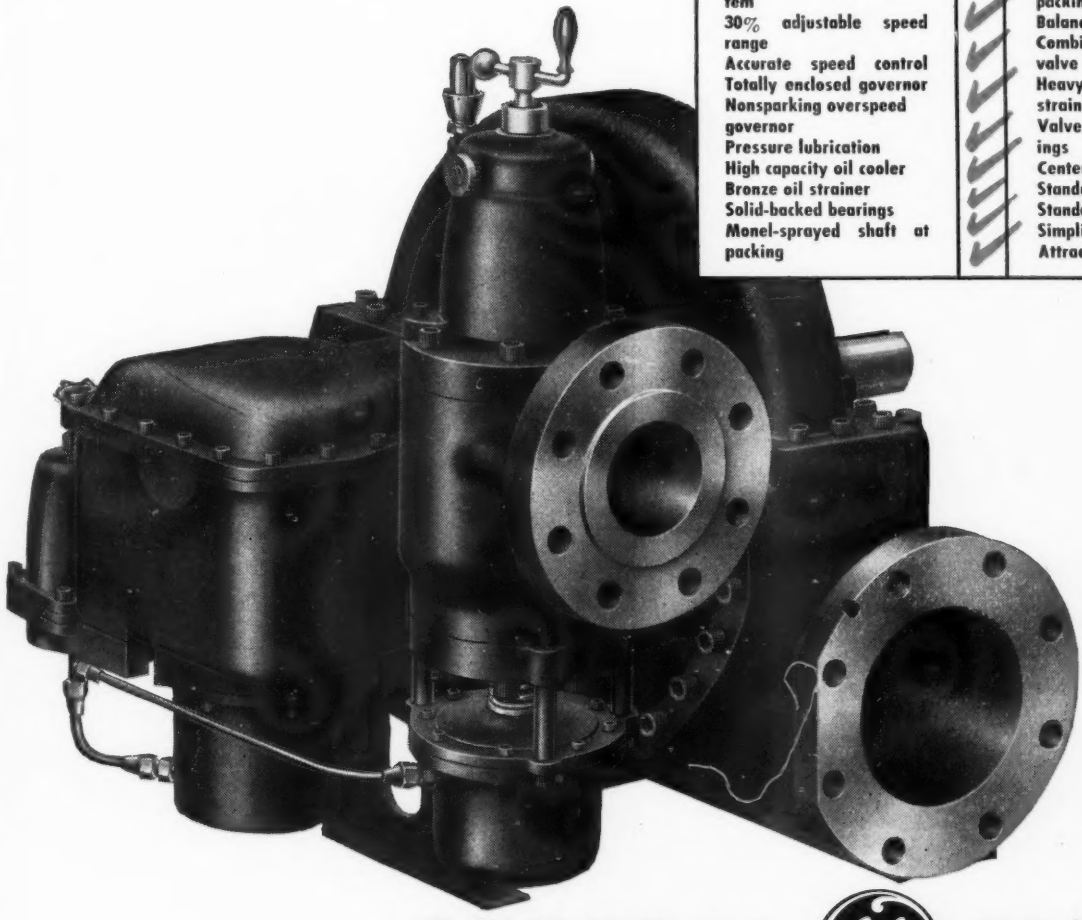
NEW G-E TURBINE OFFERS

SPECIAL FEATURES AT NO EXTRA COST

The new Type DP turbine incorporates a host of special features —at no extra cost. Price level of the DP is the same as the previous G-E standard units.

For the full story of how these features can mean operating benefits to you, call your G-E representative. Or write today for GEA-4955, a 20-page descriptive bulletin. *Apparatus Department, Section 252-29, General Electric Company, Schenectady 5, N. Y.*

- Hydraulic governing system
- 30% adjustable speed range
- Accurate speed control
- Totally enclosed governor
- Nonsparking overspeed governor
- Pressure lubrication
- High capacity oil cooler
- Bronze oil strainer
- Solid-backed bearings
- Monel-sprayed shaft at packing
- Heavy double-seal carbon packing
- Balanced valve design
- Combined trip-throttle valve
- Heavy Monel steam strainer
- Valve stem sealing bushings
- Center-line support
- Standard shaft height
- Standardized parts
- Simplified maintenance
- Attractive, compact unit



GENERAL ELECTRIC

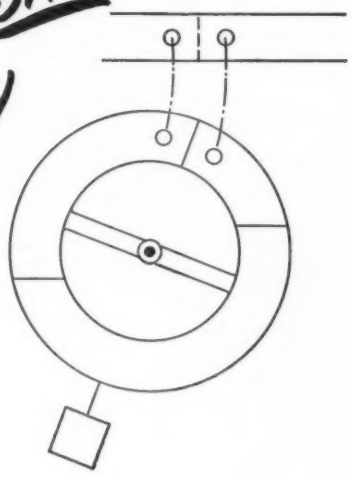
RING BALANCE METERS, SURE—

BUT BE SURE THEY ARE

HAGAN

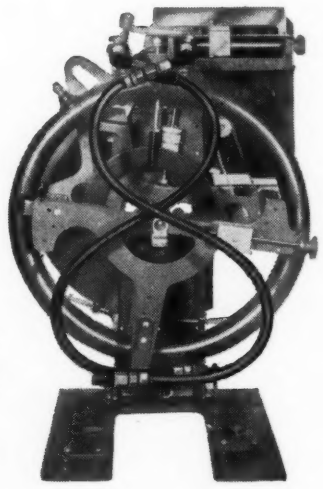
Ring Balance

this isn't new



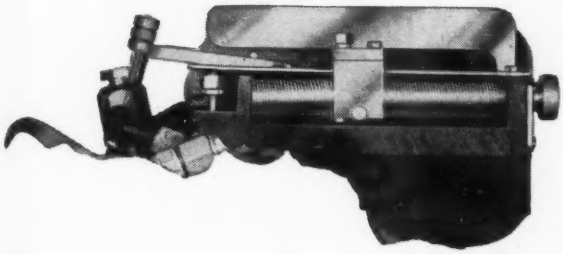
The ring balance principle is old, and flow meters based on this principle have been built both in this country and in Europe. But all of them, except the meter which Hagan now builds, had features which largely offset the advantages inherent in the ring balance principle.

this is new

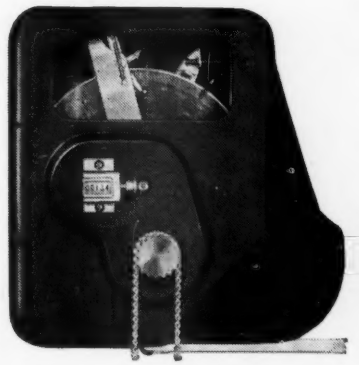


One weakness of other ring balance type meters is that connecting lines, particularly when pressures are high, tend to restrict ring motion. In Hagan Ring Balance meters, this difficulty is completely eliminated in a most simple and direct fashion—by the use of S-shaped connecting tubes. This feature is patented, and is found only in these meters.

and this is new-



Adjustment of this spring by means of a simple range screw permits a change of as much as 7 to 1 in differential pressure. Even at low flows, this unique spring resistance system gives high accuracy in the conversion of differential head to pen movement. Patent is pending.



and so is this

The integrator, another patented feature of Hagan Ring Balance meters, is an independent unit easily added to or removed from a standard meter assembly. It is simple in design; accurate between 2% and 100% of meter range; calibrated by a single adjustment; and easily checked, either under test conditions or with the meter in service.

For full information on Hagan Ring Balance Flow Meters, write for Hagan Bulletin 2M48. Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

HAGAN HALL BURGMIN CALGON

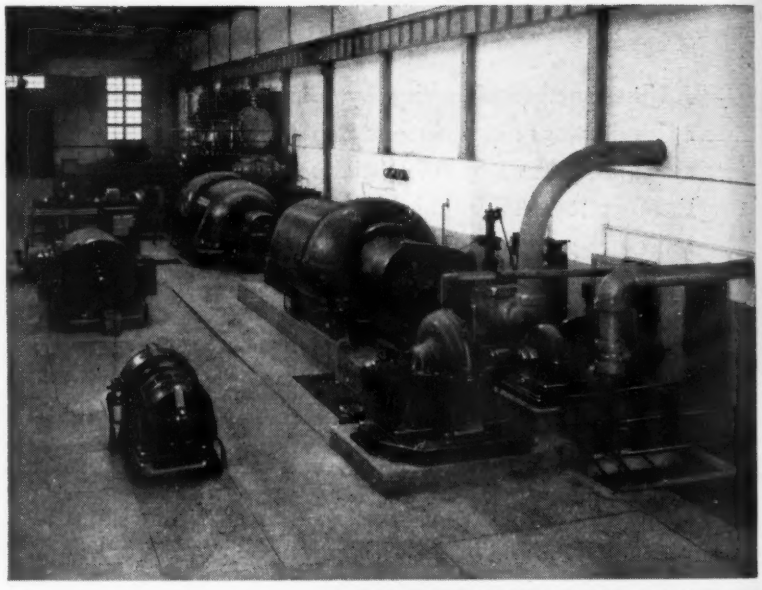
HAGAN CORPORATION

HAGAN BUILDING, PITTSBURGH 30, PA.

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES

DETROIT PUBLIC LIBRARY

Is your turbine operation this safe?

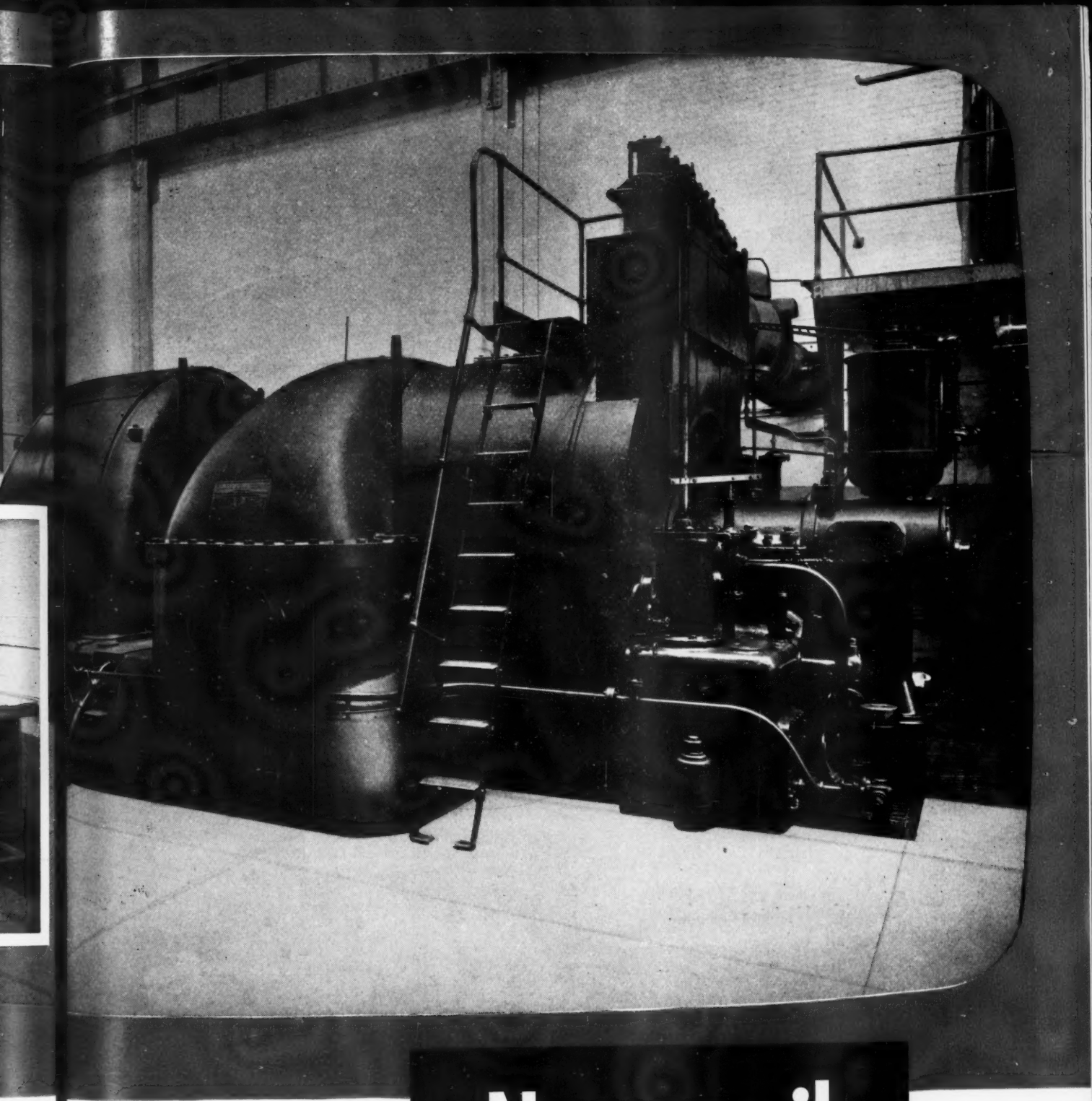


In 1938, the midwest utility plant shown at right put Nonpareil Turbine Oil into a 6,000 KW unit. A year later, a shift to Nonpareil was made on one 10,000 KW turbine and, in 1941, on a second 10,000 KW unit. The original fills of oil have not needed to be removed or replaced in the seven to ten years of operation. The oil has not been treated or rested, yet neutralization numbers have stayed below 0.10. Results: no outage time for oil-system maintenance, no downtime due to acidity troubles. Moreover, these turbines are protected against such outages for the life of each unit.

Nonpareil Turbine Oil will not increase in acidity above 0.15 mg. KOH/gm no matter how long it remains in the turbine. This is guaranteed in writing and is borne out by performance records covering 20 years. Nonpareil assures clean operation because (1) deposit-forming hydrocarbons are removed from the oil by the refining process . . . (2) acidity increase and the formation of sludge are prevented by an oxidation inhibitor in the oil. To clinch safe turbine operation, an anti-foam agent and a corrosion inhibitor are added to Nonpareil.

A Standard Oil Lubrication Engineer will be glad to supply you facts and figures from 20-year service records of Nonpareil Turbine Oil. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

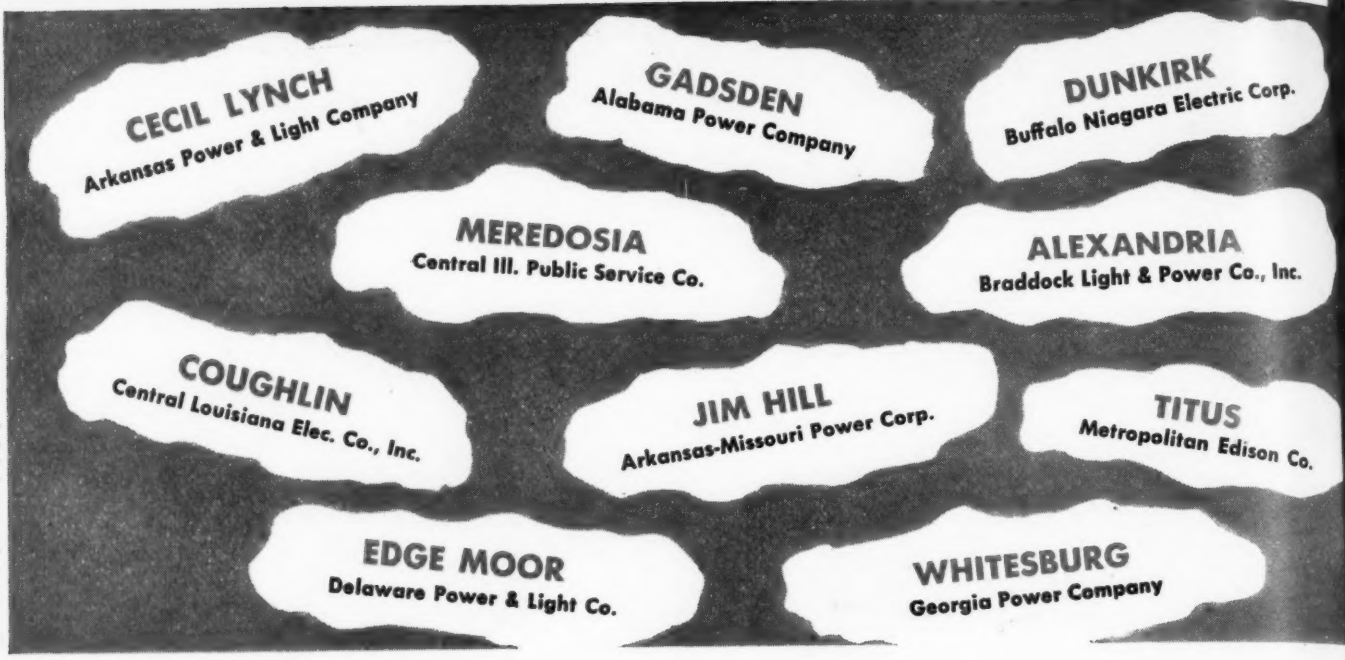
STANDARD OIL COMPANY (INDIANA



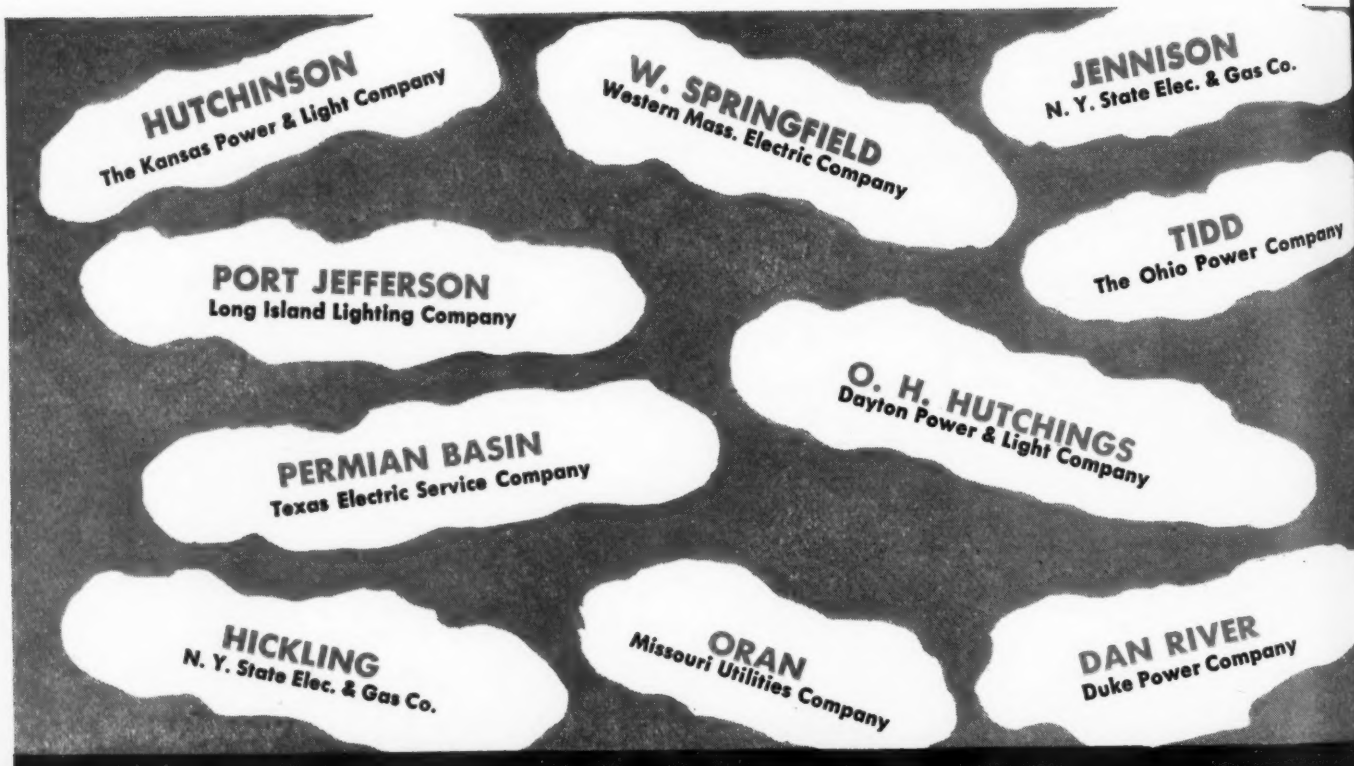
Nonpareil Turbine Oil

STANDARD OIL COMPANY (INDIANA)

STANDARD



3½ Million KW in



COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

DALLAS
Dallas Power & Light Co.

HAVANA
Illinois Power Company

SEWAREN
Public Service Elec. & Gas Co.

POSSUM POINT
Virginia Elec. and Power Company

REX BROWN
Mississippi Power & Light Co.

CUTLER
Florida Power & Light Co.

TWIN CITIES
Northern States Power Company

WHITE RIVER
Indianapolis Power & Light Co.

SALUDA RIVER
Duke Power Company

SANDOW
Pacific Gas & Electric Company

NEW Utility Stations

NEW power stations on new sites — placed in operation since the end of the war, now under construction, or in the engineering stage — will make a major contribution to capacity needs of privately owned utilities in all parts of the country. Because they reflect the latest advances in equipment and practice, they will also contribute importantly to the economy of power generation.

The steam requirements of some 3½ million kilowatts in the new stations listed here will be supplied by C-E Steam Generating Units.

This vast experience in designing boilers to meet the exacting performance standards of modern utility practice is reflected in present-day C-E designs for industrial plants — large or small. In terms of practical benefits to you, this means you can assure yourself of minimum steam costs for your next boiler installation by coming to C-E.

C-E

B-247

LAKESIDE
Rochester Gas & Elec. Corp.

WOOD RIVER
Illinois Power Company

B. C. COBB
The Consumers Power Co.

C-E ENGINEERING

200 MADISON AVENUE, NEW YORK 16, N. Y.

...A NEW

LUNKENHEIMER
200 LB. BRONZE UNION BONNET GATE VALVE

The new Lunkenheimer 200 Lb. Bronze Union Bonnet Gate Valve incorporates the first application of full cylindrical body sections in bronze gate valves. This construction, previously used only in higher pressure steel valves, provides great strength and maximum resistance against distortion of the valve body and seats due to internal pressure strains and other stresses. Tests made under the most severe conditions prove that this design will not distort and will maintain initial proportions and seat tightness.

In addition to the cylindrical body construction and other service-giving features, these valves employ Lunkenheimer's patented Alloy Stems which eliminate stem thread failure due to wear.

ESTABLISHED 1862

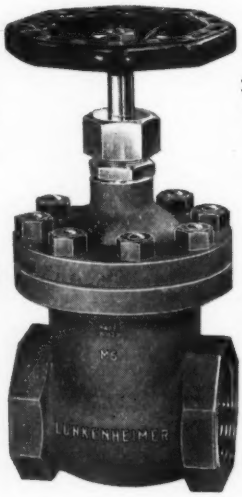
THE LUNKENHEIMER CO.

—"QUALITY"—

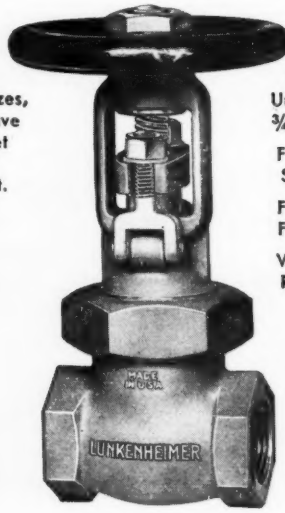
CINCINNATI 14, OHIO. U. S. A.

NEW YORK 13, CHICAGO 6, BOSTON 10, PHILADELPHIA 34, EXPORT DEPT. 318-322 HUDSON ST., NEW YORK 13, N. Y.

Union Bonnet
¼ to 2 inches
Fig. 2230 — Screw Ends
Fig. 2231 — Flange Ends
Wedge Disc, Non-rising Stem



2½" and 3" sizes, all patterns have bolted bonnet instead of union bonnet.



O.S. & Y.
Union Bonnet
¾ to 2 inches
Fig. 2232 — Screw Ends
Fig. 2233 — Flange Ends
Wedge Disc, Rising Stem

HIGH IN BRONZE GATE VALVE DESIGN

Note these features:

1. Full cylindrical body sections.
2. Patented, wear-resistant stem eliminates stem-thread failure.
3. Hex-head gland simplifies repacking.
4. Ample, long-thread stuffing box.
5. Perfectly machined repacking seats.
6. Valve is easily disassembled.
7. Easy-grip, non-heating handwheel.
8. Self-adjusting double wedge discs.
9. Stay-on discs make assembly easy.

Complete information is given in Circular No. 534. Ask your Lunkenheimer Distributor for a copy or write us direct.

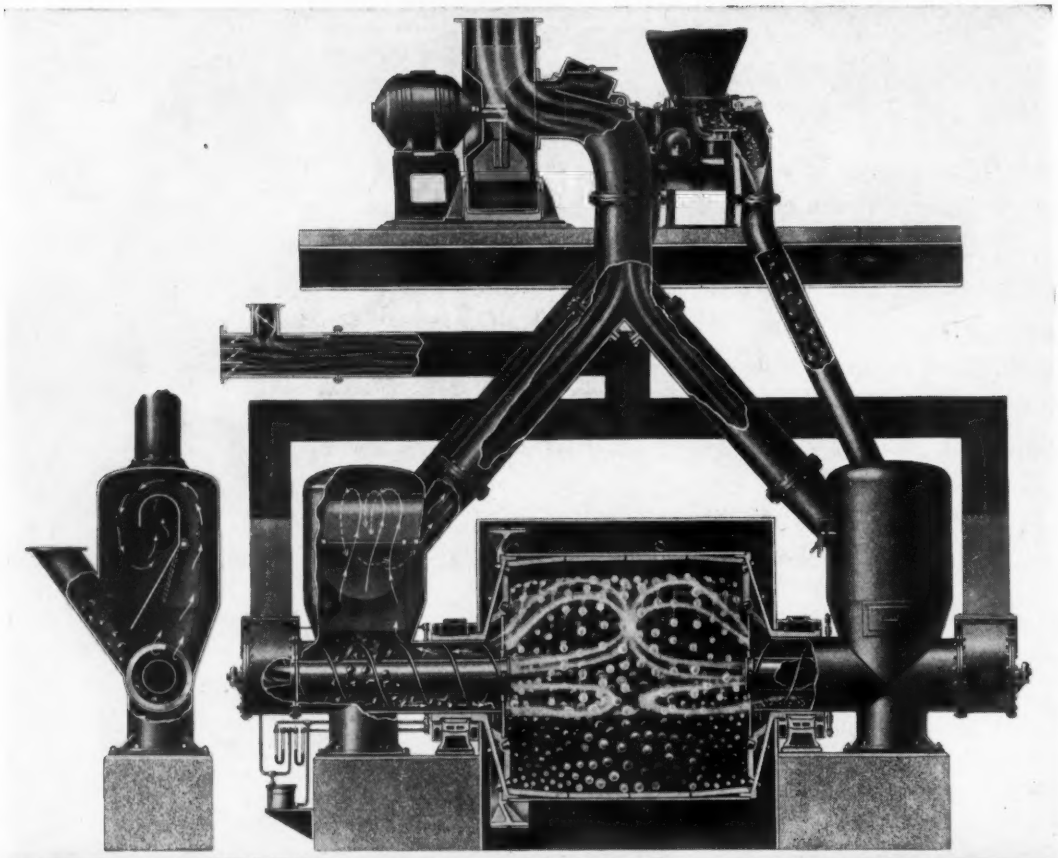
Fig. 2228—Screw Ends

Fig. 2229—Flange Ends

Double disc rising stem

LUNKENHEIMER VALVES

The FW Ball Mill provides



Sectional view of the FW ball mill pulverizer. The ball mill provides one of the most effective methods of pulverizing hard or abrasive fuels. This ball mill pulverizer, developed by FW, incorporates a high degree of efficiency, availability, and economical operation.

Outstanding Features

1. Large Reserve Capacity
2. High Availability — Low Maintenance
3. Constant Fineness
4. Successful Installations for Pulverizing
   - a. Anthracite Coal
   - b. Bituminous Coal
   - c. Coke Breeze
   - d. Lignite
   - e. Petroleum Coke
5. Systems with All Component Parts
6. 50 Years Background

constant fineness of pulverization

3

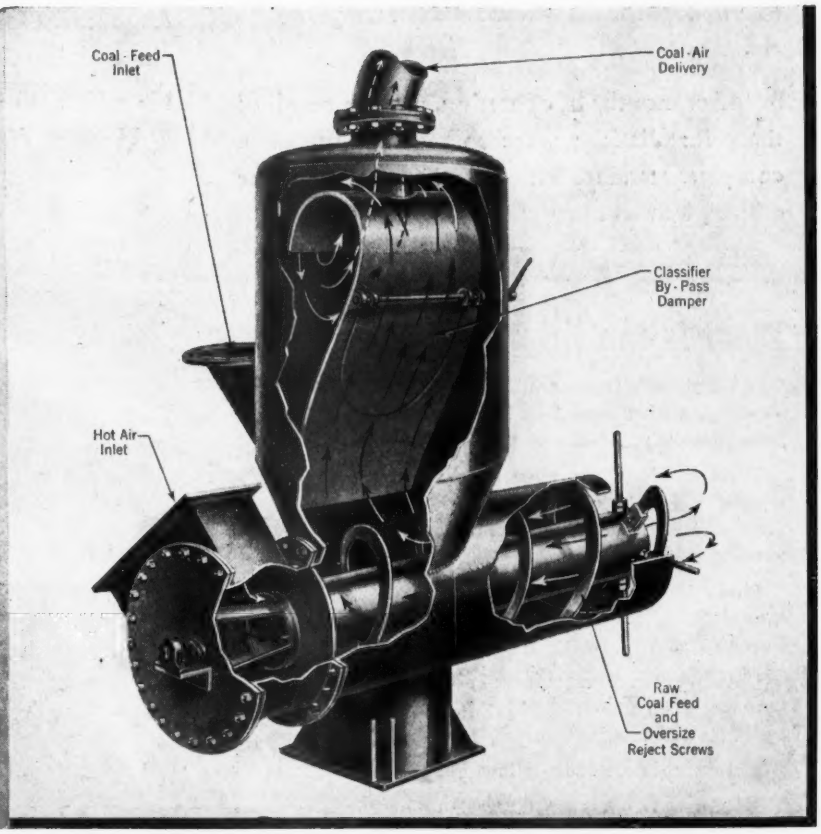
Regardless of its length of service, the FW Ball Mill—with a given coal and under uniform conditions—pulverizes fuel to a constant fineness. As the forged steel balls wear, they are replaced by the addition of small quantities at selected intervals while the mill is in service, thus maintaining the pulverizing medium at peak efficiency. Because of this, the FW Ball Mill has a much higher availability than other mills which must shut down frequently for replacement of worn parts.

Decided advantages of constant fineness of pulverization are:

Uniform Combustion • Reduced Slagging • Higher Sustained Annual Boiler Efficiency—Reduced Carbon Loss.

FOSTER WHEELER CORPORATION • 165 Broadway, New York 6, New York

FOSTER WHEELER



Cutaway view of classifier assembly. Preheated primary air enters the ball mill through a central air tube at each end of the mill. This air picks up its load of pulverized coal in the mill and travels through the annular space around the central air tube. In the classifier the coal-air stream is subjected to a cyclonic action that throws out oversized particles which are returned with the raw coal feed. The coal-air stream, containing only pulverized particles of required fineness, leaves the classifier through the center outlet shown at top.

FUSETRONS' Time-Lag STOPS Needless SHUT DOWNS ....Holds Harmless Overloads

As shown by this Example

"In 1941 our electrical superintendent and his assistant had test installations of Fusetrons made in many different sections of this plant.

"The spots chosen were those where needless blowing of fuses was causing trouble as on the drawing machines in the rod and nail mills, the 600 ampere main circuit feeding three 50 h.p. cranes, and motors in the open hearth department where ambient temperatures run very high.

"After months of operation, reports on all of these installations were so satisfactory that a complete standardization on Fusetrons for our entire plant was made.

"After over two years of standardization on Fusetrons a report from our general storekeeper showed that replacement cost on Fusetrons was about one-third of the former cost with renewable fuses.

"Naturally, the savings must be far greater due to elimination of production interruptions. Actually, we can probably credit Fusetrons to a large extent for the all-time records we have set since we installed them — because we have had the same plants and equipment that we had had in previous years."

A Large Steel Plant
(Name on Request)

What is the Fusetron?

The Fusetron is Bussmann's dual-element fuse — a fuse with tremendous time-lag and much less electrical resistance.

Fusetrons have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to the same dimensions as ordinary fuses, Fusetrons fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

BUSS

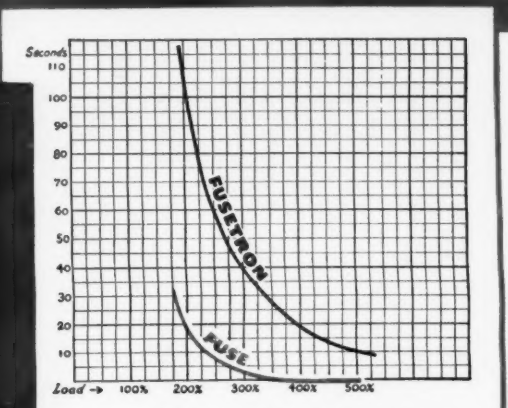
Keep Your Men and Machines on the Job!

With Fusetrons installed throughout your electrical system you will be entirely free of shutdowns caused by fuses blowing on motor-starting currents or other harmless overloads.

It is the time-lag of Fusetrons that does it. For instance: at 300% load a 30 amp. 250 volt Fusetron will hold 39 seconds before opening — yet the ordinary fuse with the longest time-lag will blow in 2/10 seconds. The Fusetron holds 15 times as long.

Other size Fusetrons in both 250 and 600 volt types show similar results . . . yet —

With all this time-lag there is no sacrifice of safety as is assured by the Underwriters' Laboratories inspected label carried by Fusetrons.



Ability of Fusetrons to hold starting currents or other harmless overloads is shown by above curve on 30 amp., 250 volt size. Other 250 volt sizes and 600 volt sizes show similar results.

Why worry with Electrical Shutdowns? — do something about them.

The tremendous time-lag of Fusetrons wipes out needless shutdowns so completely that you are able to:

Start all the motors on a circuit at one time — and the Fusetrons won't open.

Have machines momentarily jam or be overloaded — and the Fusetrons won't open.

Throw a bank of welders across the line — and the Fusetrons won't open.

Load your circuits nearer to the capacity of your switches and panelboards — and not be penalized by recurring useless shutdowns.

If you want the nearest thing to complete freedom from needless interruptions of electrical service, without in any way sacrificing safety — install Fusetrons throughout your entire electrical system.

Fusetrons GIVE MANY Kinds of Protection Heretofore NOT Available

★ Entirely wipe out needless blows caused by motor starting currents or other harmless overloads.

★ Give Thermal Protection to Panelboards and Switches.

★ Operate cooler because of lesser resistance, thus prevent needless blows caused by heating in panelboards and switches.

★ Permit use of larger motor or adding more motors on circuit WITHOUT installing larger switch or panel.

★ On new installations, PROPER size switches and panels can be used instead of OVERSIZE.

★ Protect small motors against burnout, simply and inexpensively.

★ Give DOUBLE protection to large motors.

★ Provide simplest way to stop burnouts from single phasing.

★ Protect coils, transformers and solenoids against burnout.

Get All the Facts—Find out how it will pay you to install Buss Fusetrons throughout your electrical system.

One needless shut down — or one lost motor — or one destroyed panel, may cost you far more than replacing every fuse with a FUSETRON.

Don't risk such losses — protect yourself by changing over your entire electrical system to FUSETRONS.

FUSETRONS

Sold Through Wholesalers

Send the Coupon Now!

Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.)

Please send me complete facts about BUSS Fusetrons.

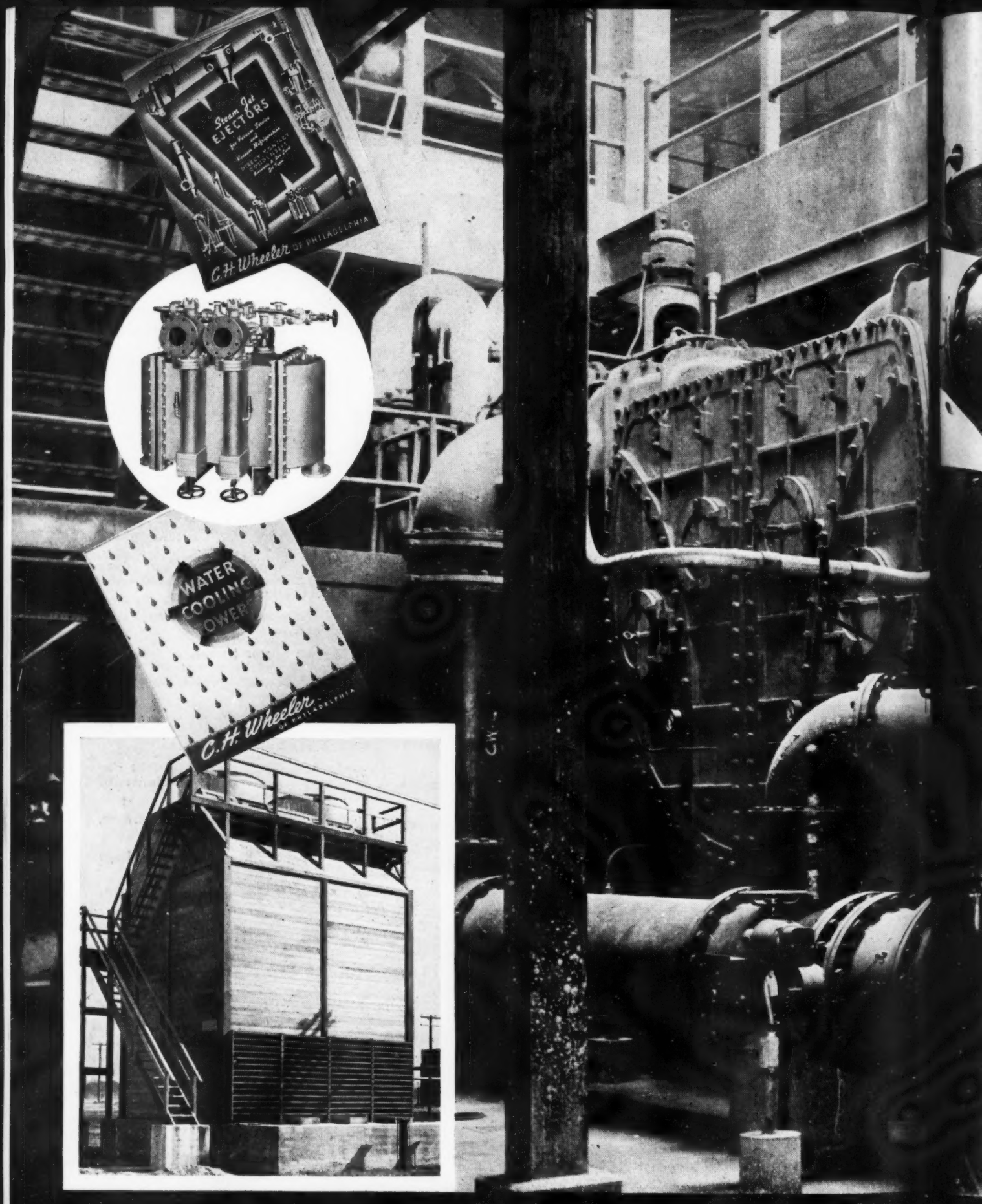
*Name*_____

*Title*_____

*Company*_____

*Address*_____

*City*_____ *State*_____ 948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EJECTORS
for Vacuum Service
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C.H. Wheeler OF PHILADELPHIA
WATER
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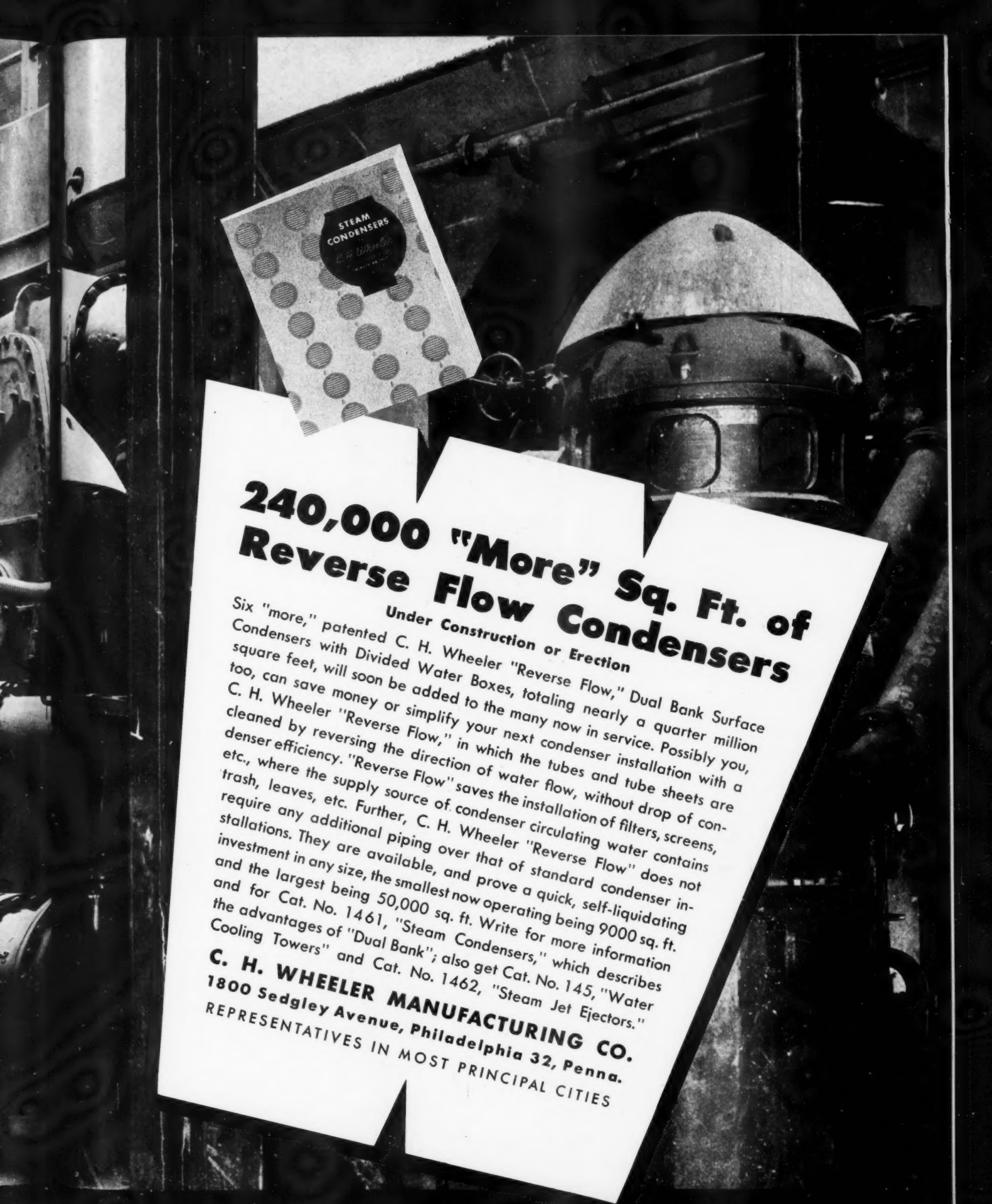


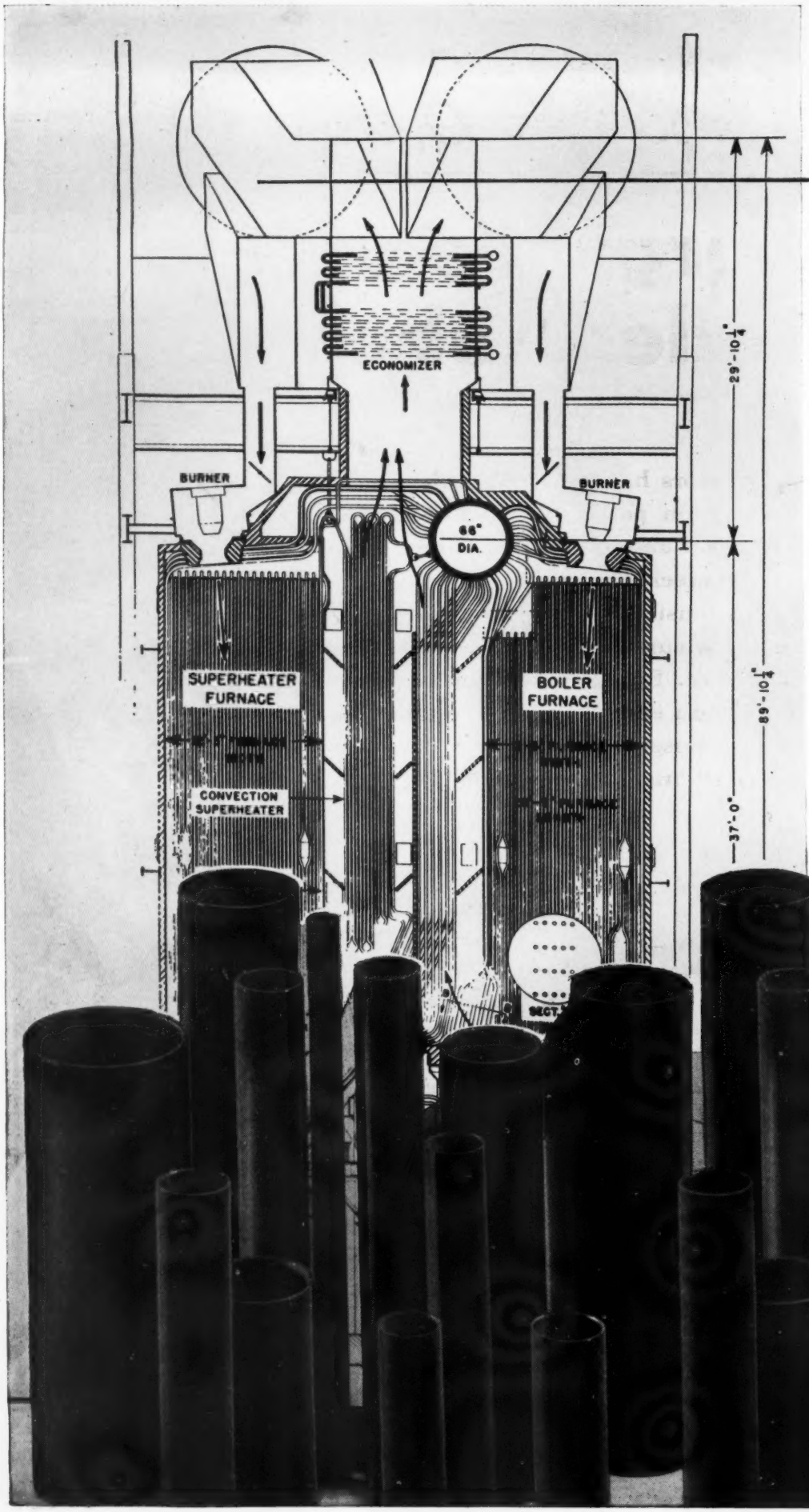
240,000 "More" Sq. Ft. of Reverse Flow Condensers

Under Construction or Erection

Six "more," patented C. H. Wheeler "Reverse Flow," Dual Bank Surface Condensers with Divided Water Boxes, totaling nearly a quarter million square feet, will soon be added to the many now in service. Possibly you, too, can save money or simplify your next condenser installation with a C. H. Wheeler "Reverse Flow," in which the tubes and tube sheets are cleaned by reversing the direction of water flow, without drop of condenser efficiency. "Reverse Flow" saves the installation of filters, screens, etc., where the supply source of condenser circulating water contains trash, leaves, etc. Further, C. H. Wheeler "Reverse Flow" does not require any additional piping over that of standard condenser installations. They are available, and prove a quick, self-liquidating investment in any size, the smallest now operating being 9000 sq. ft. and the largest being 50,000 sq. ft. Write for more information and for Cat. No. 1461, "Steam Condensers," which describes the advantages of "Dual Bank"; also get Cat. No. 145, "Water Cooling Towers" and Cat. No. 1462, "Steam Jet Ejectors."

C. H. WHEELER MANUFACTURING CO.
1800 Sedgley Avenue, Philadelphia 32, Penna.
REPRESENTATIVES IN MOST PRINCIPAL CITIES

EAM CONDENSERS • WATER COOLING TOWERS
ECTORS • STEAM JET VACUUM REFRIGERATION
F PHILADELPHIA


ECONOMIZER
BURNER
BURNER
66"
DIA.
SUPERHEATER
FURNACE
BOILER
FURNACE
CONVECTION
SUPERHEATER
29'-10¼"
89'-10¼"
37'-0"

For Economical High Pressure and Temperature Operation

Pittsburgh Seamless Boiler Tubes

Boiler operators have long recognized the economy of operation possible with Pittsburgh Steel Seamless carbon and alloy boiler tubes. The sound homogeneous steel, the closely controlled chemistry, the high tensile strength, combined with ductility and size accuracy give you ease of installation and long service. Pittsburgh Boiler Tubes are produced with plain ends or can be supplied swaged, expanded, or upset. Pittsburgh Steel Company, 3220 Grant Building, Pittsburgh 30, Pa.

Answering a reader's question on smoke and soot conditions, the BERGEN ENGINEER, official organ of the Bergen County Chapter of the N.A.P.E., replied in a recent issue

> *". . . Any stoker will burn any kind of coal after a fashion, but only coal of definite characteristics* EFFICIENTLY . . ."

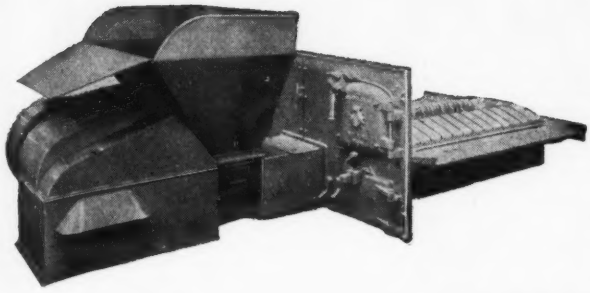
The coals that are available to *you* are the coals you are interested in. The stoker that will burn *those* coals efficiently is your natural requirement. And C-E supplies that need with the most complete line of stokers available *anywhere*. Here you are free to choose, from all basic types, the stoker that exactly fits your three-way problem of fuel characteristics, load and operating conditions. No need to settle for a compromise that will burn your coal "after a fashion".

Getting the *right* stoker is more important than ever today as coal costs rise, for the cost of fuel burned soon far outweighs the original equipment cost. Careful selection of stokers means dividends in dollars as well as operating satisfaction. Let C-E engineers help you in this choice. More than 19,500 C-E stokers, serving all industries and burning every type of coal, provide an impressive background of experience. And C-E's *complete* line assures you an unbiased recommendation . . . the experienced judgment of a manufacturer that has no axe to grind. B-246

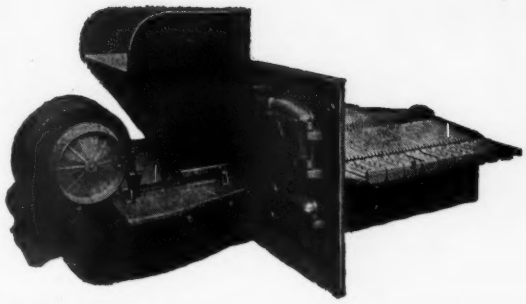
C-E

COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS. ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

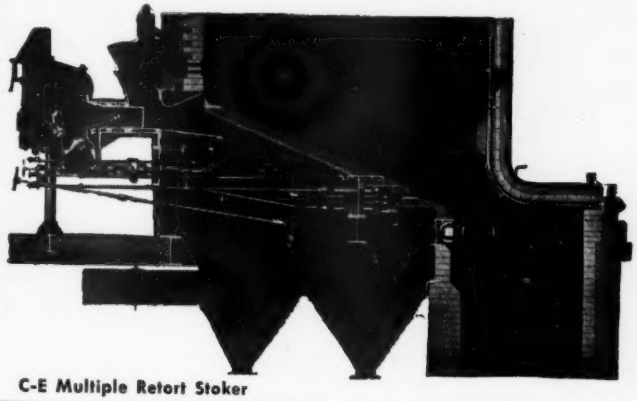


C-E Skelly Stoker

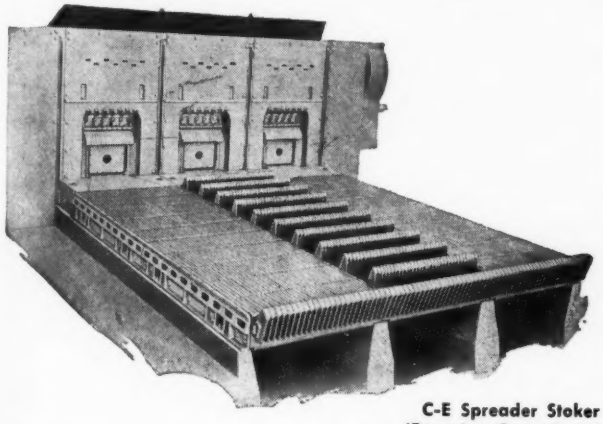


C-E Low Ram Stoker

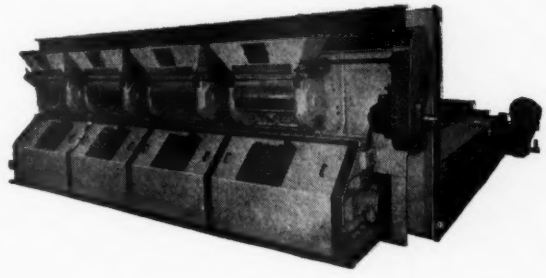
C-E Type E Stoker



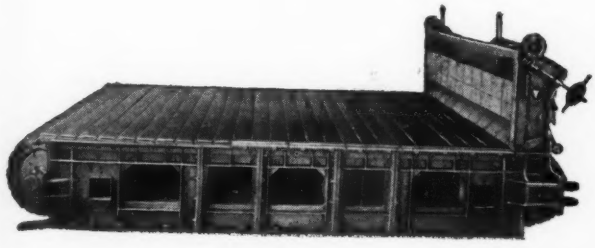
C-E Multiple Retort Stoker



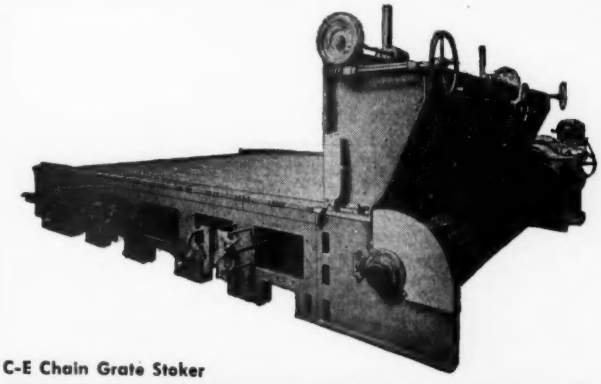
C-E Spreader Stoker
(Dumping Grate Type)



C-E Spreader Stoker
(Continuous Discharge Type)



C-E Traveling Grate Stoker



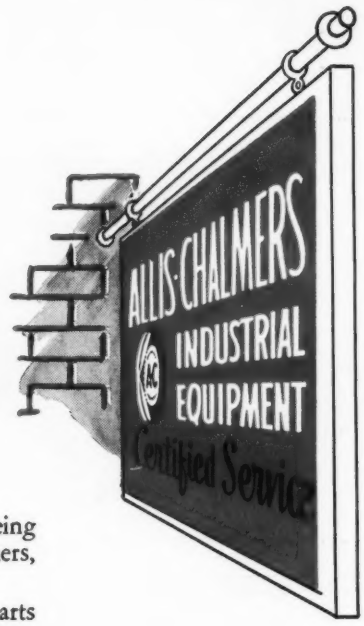
C-E Chain Grate Stoker

E N G I N E E R I N G

2 0 0 M A D I S O N A V E N U E , N E W Y O R K 1 6 , N Y

"Certified" Service

AN ADDED REASON FOR INVESTING IN ALLIS-CHALMERS MOTORS!



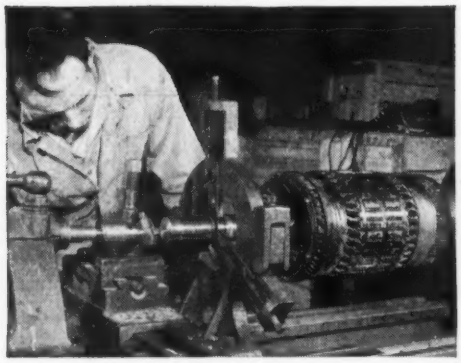
IT MEANS: 1) *Better, Faster Service.* Independent local repair shops are now being selected and authorized to service and repair Allis-Chalmers Motors, Transformers, Controls, Pumps — and "Certify" them as to workmanship.

2) *Finest Parts and Workmanship.* Shops use genuine Allis-Chalmers repair parts — or parts of equal quality; and are given complete service information, including factory procedure and drawings where necessary.

3) *Friendly Service.* Every Allis-Chalmers "Certified" Service Shop has been selected on the basis of its reputation in its community. It's the kind of company you *like* to do business with!

How can you get this service? For the present most "Certified" Service Shops are located in the larger U. S. industrial areas . . . but they're expanding rapidly. Call your nearby A-C District Office or Authorized Dealer for closest recommended shop. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

FINER, FASTER, FRIENDLIER SERVICE FOR INDUSTRY!



The A-C Supply Company of Cuyahoga Falls, Authorized Allis-Chalmers Dealer and newly-appointed "Certified" Service Shop, is staffed and equipped to give prompt, efficient, top-quality repair and service aid to customers in the greater Akron industrial area. Typical of the kind of "Certified" Service organizations being selected throughout U.S.

MANY SIZES, RATINGS OF ALLIS-CHALMERS STANDARD SQUIRREL-CAGE MOTORS ARE NOW AVAILABLE FROM STOCK. CHECK YOUR AUTHORIZED A-C DEALER, OR DISTRICT OFFICE FOR DETAILS.

A 2506

ALLIS-CHALMERS

One of the Big 3 in Electric Power Equipment—Biggest of All in Range of Industrial Products

You Fit Your Bat to Your Game

BUY V-BELTS THE SAME WAY

YOU'D never play badminton with a baseball bat. Or cricket with a tennis racket. Using *one* V-belt type to meet all the variations of V-drive operating conditions is out of place, too.

So Goodyear makes industry's most complete line of V-belts. Choose the proved construction that meets your drive requirements—built with oil-resistant, heat-resistant or non-static rubber, if needed.

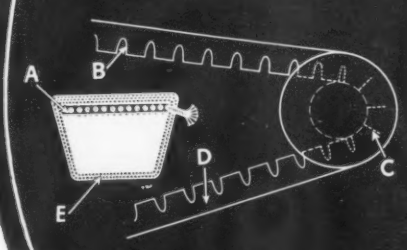
To end stretch and maintenance problems, there's Goodyear's exclusive COMPASS-V-STEEL belt, with wiry, super-strength steel-cable load carriers. To meet sudden overloads and shock stresses, Goodyear has belts sinewed with multiple, high-tensile, resilient cords. Still other Goodyear belts with single-plane, endless-cord load carriers deliver high flex-life on fast, small-pulley, short-center drives. And there's Goodyear's open-end V-belting with special body of high fastener strength fabric.

Drive-Fitted By the G.T.M.

To insure belting with the V-belt that's *right* for your particular problem, consult the G.T.M.—Goodyear Technical Man. He'll recommend the proper Goodyear V-belt to give you long, trouble-free service at the lowest cost in the long run. Write him c/o Goodyear, V-Belt Sales Dept., Akron 16, Ohio.

GOODYEAR INDUSTRIAL RUBBER PRODUCTS

GTM-Specified COMPASS-V-STEEL BELT



- **A** Load-carrying section of endless high-tensile steel cable.
- **B** Vents open between pulleys, dissipating heat.
- **C** Vents compress rounding pulleys, giving continuous gripping surface.
- **D** Highest quality rubber underbody.
- **E** Sturdy, bias-laid fabric cover resists wear.

1898 GOODYEAR 50 ANNIVERSARY 1948

FOR BELTS, HOSE, MOLDED GOODS, PACKING, TANK LINING built to the world's highest standard of quality, phone your nearest Goodyear Industrial Rubber Products Distributor.

Compass—T.M. The Goodyear Tire & Rubber Company

GOODYEAR

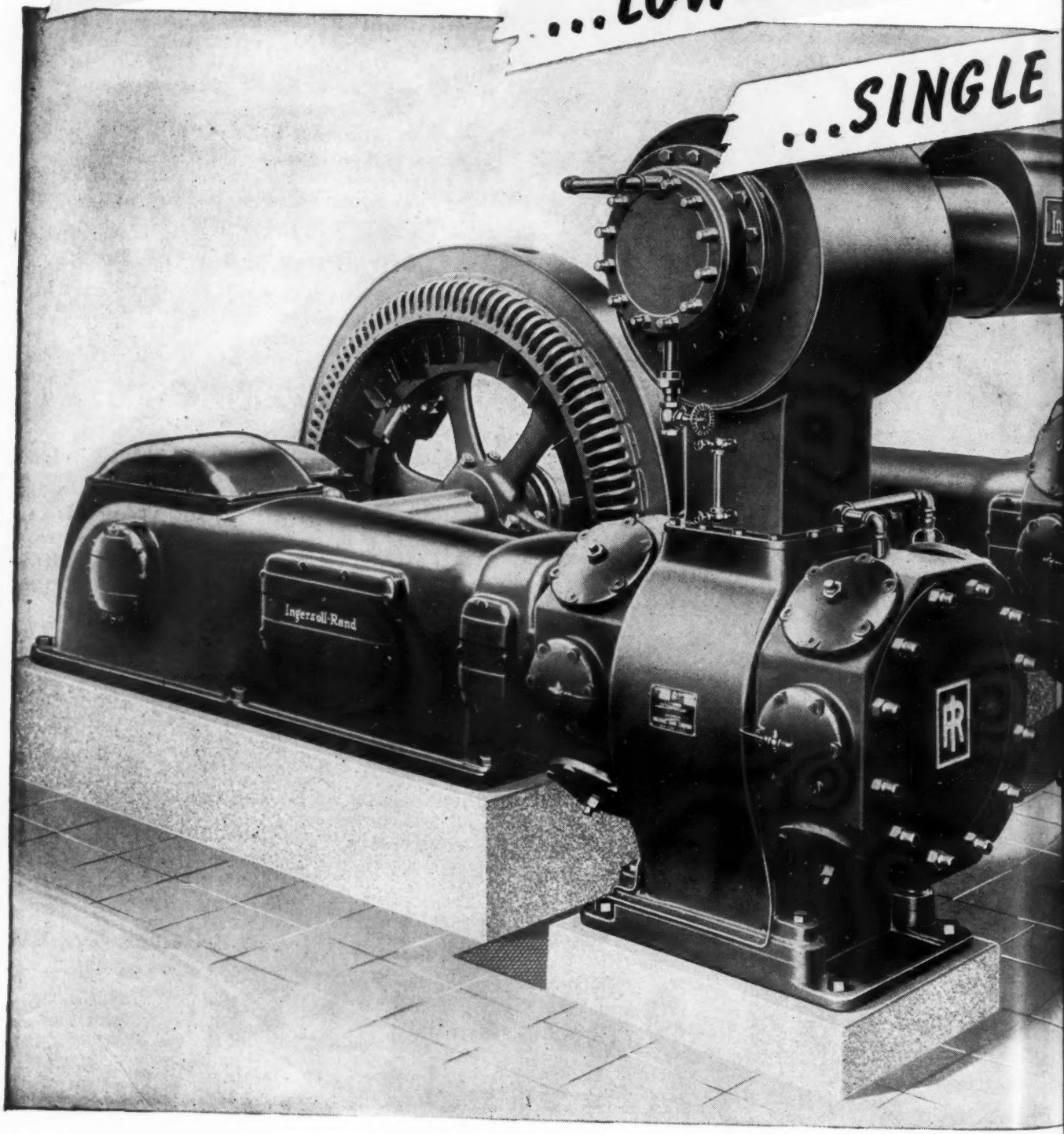
V-BELTS

RUBILENE OILS . .

. . . LARGE and SMALL

. . . LOW PRESSURE

. . . SINGLE

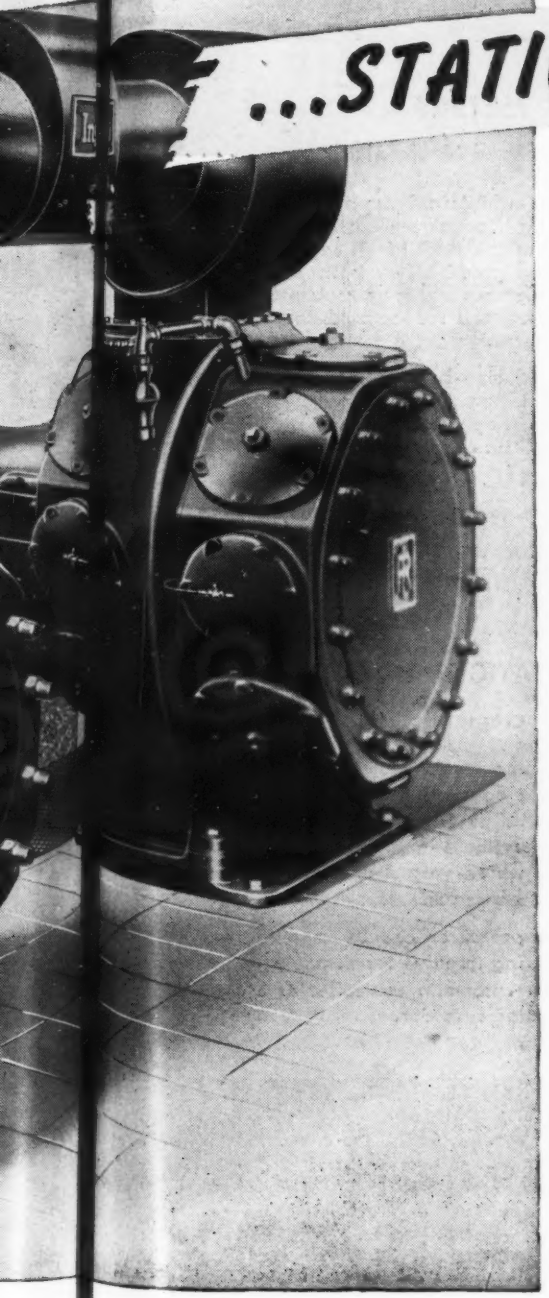


for Air Compressors

and HIGH PRESSURE

-STAGE and MULTIPLE-STAGE

...STATIONARY and PORTABLE



Regardless of size or classification, assured, uninterrupted performance of air compressors depends largely on lubrication. High stability and oxidation resistance are necessary qualities of a compressor lubricant to protect against the problems of carbon formation and sticking valves.

Every grade of Sinclair RUBILENE is always fully refined to meet these requirements. Whether of low-viscosity or heavy body, RUBILENE is always top quality, always uniform.

Write for expert consultation on the use of rugged RUBILENE for all compressors.

SINCLAIR

INDUSTRIAL OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVE., NEW YORK 20, N. Y.

BOILER CONTROLS • INSTRUMENTS • PROCESS CONTROLS

The Republic Flow Meters Co. offers a complete manufacturing and engineering service in the field of measurement and control. We will be glad to co-operate with you in the solution of any metering or control problem, whether it involves a single instrument or the automatic control of an entire process or plant.

Republic engineers, in co-operation with your own engineers, will be glad to study your problem and make recommendations as to the most practical solution. Your inquiries will involve no obligation on your part.

BOILER CONTROLS

For All Types of Boilers

Republic offers a centralized, automatic system for controlling steam pressure, combustion, furnace pressure, excess pressure, boiler water level, etc.

Automatically regulates the fuel and air imput to a boiler in measured proportions and in a fixed ratio for the entire load range. Available for all sizes of boilers and all types of fuel firing.

FLOW METERS

Electrical and Mechanical

Republic electrical type remote reading flow meters are available for measuring the flow of all types of liquids and gases. Meter bodies are built for line pressures up to 10,000 p. s. i. and for all ranges of differential pressures.

Mechanical ring-balance meters are built for static pressures up to 2500 p.s.i. and to operate on differentials as low as 3 in. of water.

BOILER METERS

Record Steam Flow—Air Flow

The Republic boiler meter records simultaneously on one chart the steam flow from the boiler and the rate of air flow to the furnace for combustion.

The air flow pen is adjusted to record coincident with the steam flow pen when the furnace is receiving the proper amount of air for maximum combustion efficiency.

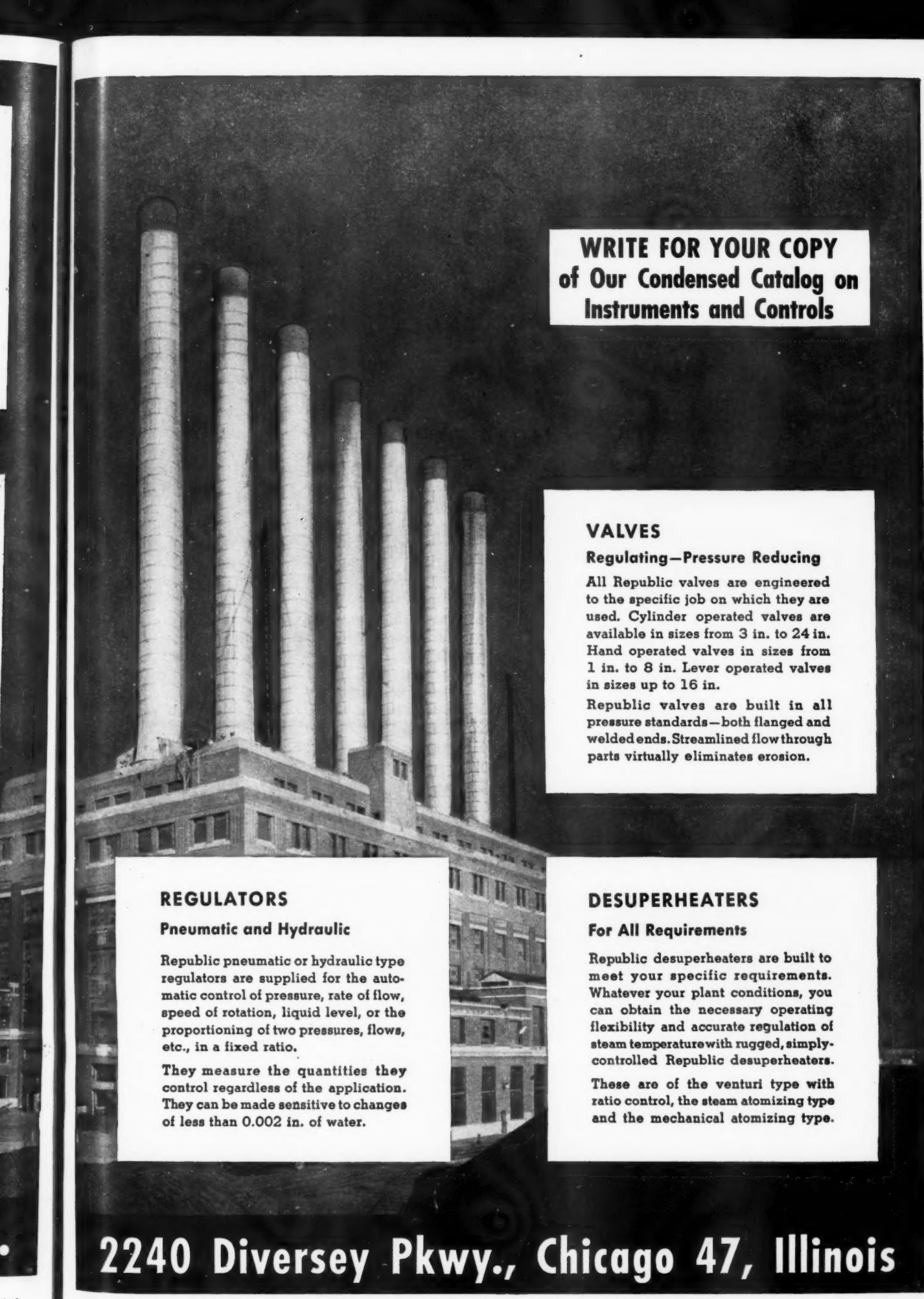
PNEUMATIC TRANSMITTERS

For Measurement and Control

Republic pneumatic transmitters are devices for converting process variables, such as flow, liquid level, pressure or liquid density, into air pressures which vary proportionally with the process variables.

These air pressures can be used as the measuring impulse for the actuation of an automatic controller or a direct reading recorder.

REPUBLIC FLOW METERS CO.



WRITE FOR YOUR COPY
of Our Condensed Catalog on Instruments and Controls

VALVES

Regulating—Pressure Reducing

All Republic valves are engineered to the specific job on which they are used. Cylinder operated valves are available in sizes from 3 in. to 24 in. Hand operated valves in sizes from 1 in. to 8 in. Lever operated valves in sizes up to 16 in.

Republic valves are built in all pressure standards—both flanged and welded ends. Streamlined flow through parts virtually eliminates erosion.

REGULATORS

Pneumatic and Hydraulic

Republic pneumatic or hydraulic type regulators are supplied for the automatic control of pressure, rate of flow, speed of rotation, liquid level, or the proportioning of two pressures, flows, etc., in a fixed ratio.

They measure the quantities they control regardless of the application. They can be made sensitive to changes of less than 0.002 in. of water.

DESUPERHEATERS

For All Requirements

Republic desuperheaters are built to meet your specific requirements. Whatever your plant conditions, you can obtain the necessary operating flexibility and accurate regulation of steam temperature with rugged, simply-controlled Republic desuperheaters.

These are of the venturi type with ratio control, the steam atomizing type and the mechanical atomizing type.

2240 Diversey Pkwy., Chicago 47, Illinois

E-M Rotors

...like this put the PUSH in your INDUCTION MOTOR DRIVES

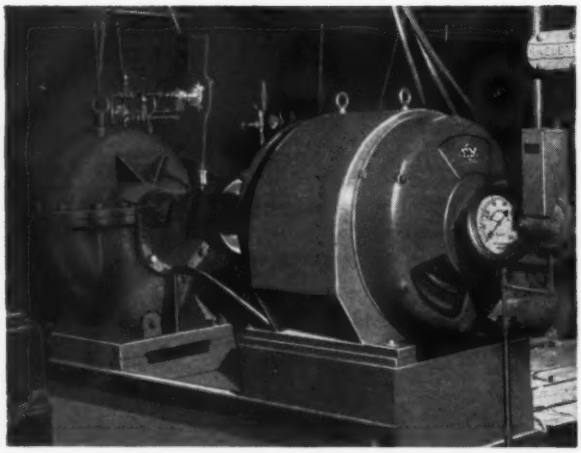
Here are rotors that are truly remarkable for their rugged construction and skilful engineering. They provide an example of the reliability that is built into E-M Heavy-Duty Squirrel-Cage Induction Motors . . . an example of still another difference that accounts for the outstanding performance of these motors on tough "big motor" drives.

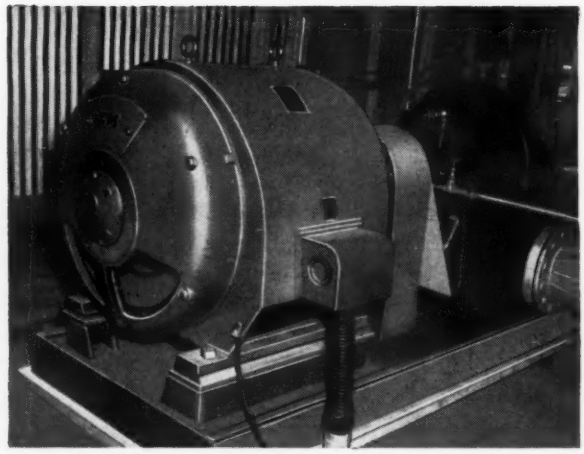
The high capacity, cage winding of the rotor in the E-M 2-Pole Induction Motor . . . its low-loss magnetic core of high silicon steel laminations . . . its extra strength shaft of forged steel . . . careful dynamic balancing . . . designing for maximum ventilation and minimum noise—these combine in a smooth-running rotor that's virtually indestructible.

A critical speed far above operating speed results from the extra large diameter of the shaft at the rotor core. Ribs of the rotor are welded directly to the shaft for stiffness. The electrical characteristics of the silicon steel laminations give minimum exciting current and heat, along with low core loss: The cage bars of oxygen-free copper have high thermal and electrical conductivity. They are Sil-Fos or phos-copper brazed to the end ring depending on application.

This kind of construction in the E-M 2-Pole Induction Motor is the answer to the need of industry for dependable, continuous performance on such tough jobs as high-speed pump, blower and compressor drives. Similarly rugged construction gives the same kind of dependability in the E-M Induction Motors of 4 poles or more for lower speed requirements. This built-in reliability would hardly be possible or practical without the knowledge acquired by E-M over many decades of manufacturing heavy-duty motors that perform faithfully and with minimum maintenance year after year. E-M's "big motor engineering" know-how pays off for you when you buy E-M Squirrel-Cage Induction Motors.

40 YEARS OF BIG MOTOR KNOW-HOW HELPS BUILD OUTSTANDING INDUCTION MOTORS

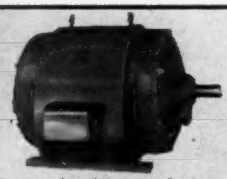




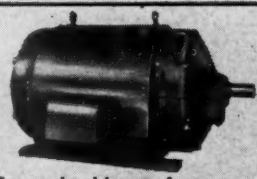
E-M Drip-Proof Heavy-Duty Induction Motors were chosen for these pumping installations, requiring extra dependability. The installation pictured at left is of a 350 HP motor in the St. Joseph Lead Company mine at Leadwood, Mo., and at right, of 400 HP motor in the pumping station of a Florida mine.

1. Rotor shaft is tough steel forging, extra thick through rotor core.
2. Cage bars are oxygen-free copper, silver-soldered.
3. Fans are designed to move large volumes of air with relatively low velocity for quiet operation.

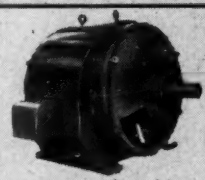
Types of E-M SQUIRREL-CAGE INDUCTION MOTORS



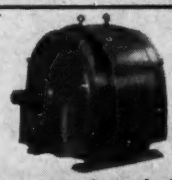
Two-pole; drip-proof; ring lubricated bearings.



Two-pole; drip-proof; pressure-lubricated bearings.



Four or more poles; drip-proof; sleeve bearings.



Four or more poles; splash-proof; ball bearings.

EXTRA VALUE CONSTRUCTION MAKES THE DIFFERENCE

● Yes . . . there are big and important differences in big motor engineering. You see them in the indestructible rotor construction of the E-M Squirrel-Cage Induction Motors. You see them also in the long-life insulation of these motors, their cool-running, wear-resistant bearings and their motor protection. They are differences that make E-M Heavy-Duty Induction Motors exceptional values. Write for our publications 189 and 190 giving full details.

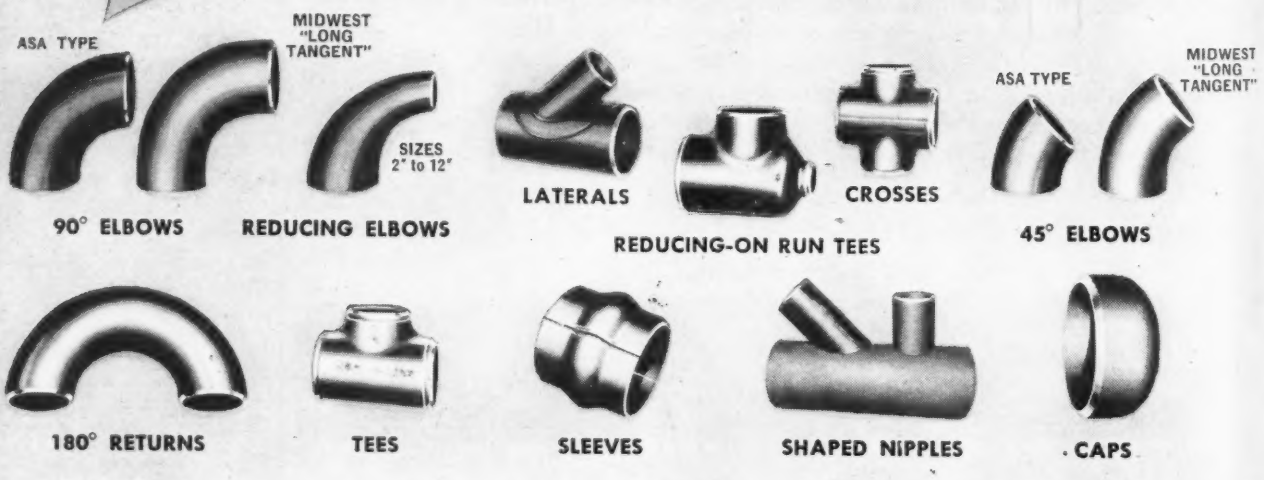
ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

E-M

SPECIALISTS IN **BIG MOTOR ENGINEERING**

1300-TPA-2058

TIME SAVED in Layout . . . TIME SAVED
Because Pipe Can be Cut in Advance . . .
TIME SAVED Lining Up and Fitting . . . .
TIME SAVED in Welding . . . . . by the
EXCEPTIONAL DIMENSIONAL
ACCURACY of MIDWEST
Welding Fittings



MIDWEST WELDING FITTINGS IMPROVE PIPING DESIGNS

Many large users of pipe welding fittings report that Midwest Welding Fittings save them important time . . . and money . . . because of their unusual accuracy to published dimensions and their exceptional uniformity. These advantages did not just happen . . . they are direct results of the unique Midwest manufacturing methods.

But savings in time and cost are not the only advantages offered by Midwest Welding Fittings. Simplified and improved piping design is also often possible. For example: the Midwest Reducing Elbow (available in sizes through 12") decreases pressure drop and turbulence when used instead of a standard elbow and reducer (it also saves more than ⅓ of the welding). Midwest Long Tangent Elbow removes weld from point of maximum bending stress and is designed to permit use of slip-on flanges. Midwest Saddles compensate for weakening of header body resulting from metal removal for nozzle opening. Midwest Sleeves relieve butt welds of bending and tensile stress. There is a distributor near you . . . it will pay you well to call on him for your welding fitting requirements.

MIDWEST PIPING & SUPPLY CO., Inc.

Main Offices: 1450 South Second Street, St. Louis (4), Mo.

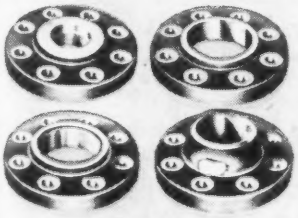
Sales Offices: **New York (7), 30 Church St.**

Chicago (3), 79 West Monroe St. • Los Angeles (33), 520 Anderson St. • Houston (2), 229 Shell Bldg. • Tulsa (3), 533 Mayo Bldg. South Boston (27), 426 First St. • Distributors in Principal Cities.

4 PLANTS ARE BETTER THAN 1

LAP-JOINT STUB ENDS

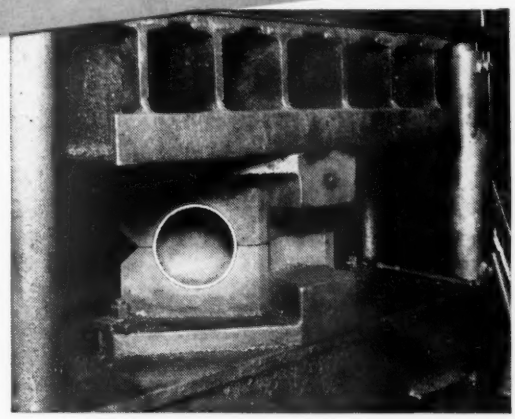
REDUCERS



FLANGES

SADDLES

Here's Why TIME IS SAVED

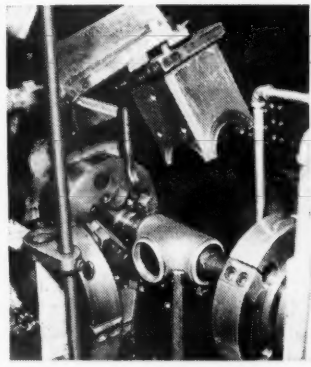


SIZING IN COMPRESSION

Midwest Elbows are first made slightly oversize. They are then reheated to forging temperature and brought to final size in compression dies. In addition to relieving forming and welding stress, this assures true circular cross section, uniform wall thickness and accurate radius, included arc and tangents.

SPECIAL MACHINING

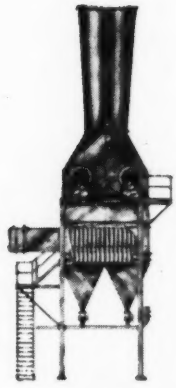
Special machines developed by Midwest simultaneously bevel the ends of Midwest Welding Fittings. This assures exact included angles and holds center-to-end dimensions well within tolerance specifications.



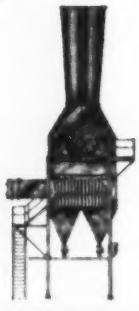
FINAL INSPECTION

Every Midwest Welding Fitting is individually checked to insure that the high standards of precision are maintained.

AND REDUCE COSTS . . .



The Secret of CONTROL



Thermix Fan Stacks produce a definite controlled degree of draft—because in a unit packaged design they combine, (1) the induced draft fan, (2) the breeching connecting the fan and stack and (3) the stack itself. All *three* are interdependent and affect the controlled, overall operation. To design, engineer and purchase these parts separately would not produce the same accurate, known results that this packaged unit offers.

And what about Tubular Dust Collectors? Thermix offers multiple small diameter tubes for high centrifugal force and resulting efficiency, plus the added advantage of smaller space requirements and more accurate dust control for your plant.

A call to the field engineer nearest you will place at your disposal a specialist in the field of flue gas control.

Project & Sales Engineers

THE THERMIX CORPORATION

First National Bank Bldg. **Greenwich, Conn.**

(Offices in 28 principal cities)

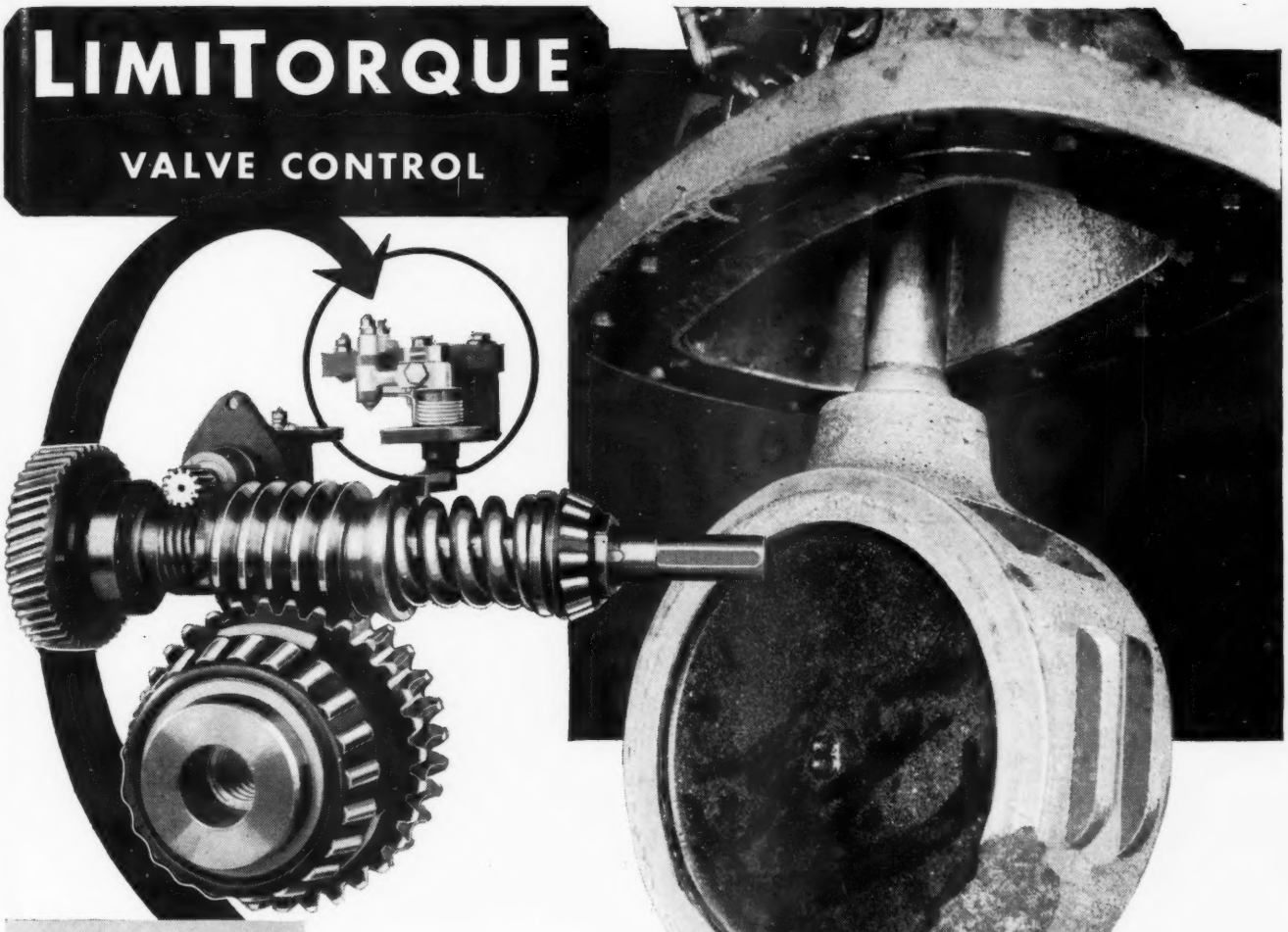
Canadian representative: **T. C. CHOWN, Ltd.,** *1440 St. Catherine St. W., Montreal 25, Quebec*

PRAT-DANIEL CORPORATION

Manufacturers of Thermix Equipment

EAST PORT CHESTER, CONN.

LIMITORQUE
VALVE CONTROL



THE TYPE "SM" LIMITORQUE

PREVENTS THIS

"LimiTorque" provides absolute assurance against improper valve seating, by means of a *positive mechanical "torque cutout"*. If an obstruction is met in the closing direction of valve disc, the Torque Limit Switch disconnects the motive power instantly. This operation protects the stem and disc of the valve, assures proper seating and eliminates valve damage. Seating torque may be varied by means of a micrometer adjustment of the mechanical torque switch.

Illustration above shows the entire internal mechanism of a Type M *"LimiTorque"*; also, the torque cutout switch arrangement. Note how simple and compact the whole machine is: no complicated gear drives, not a thing to get out of order and power applied directly to where it is used, without undue friction losses.

Other advantages of *"LimiTorque"* are: automatic push-button operation from local or remote locations; saving of time and manpower; proper speed in opening and closing valves.

Send for new 96 page *"LimiTorque"* Catalog, and please use your Business Letterhead, when writing.

Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO

IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

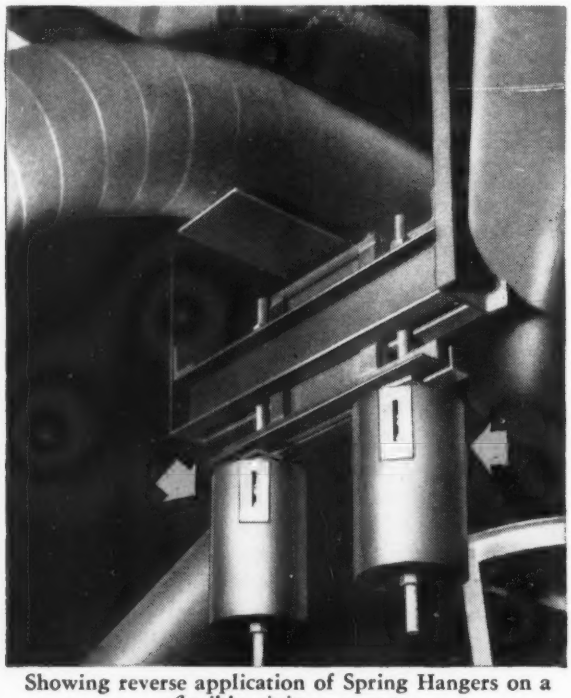
Industrial Gears and Speed Reducers
LimiTorque Valve Controls

Flexible support for pipe that S-T-R-E-T-C-H-E-S

with GRINNELL PRE-ENGINEERED SPRING HANGERS

Selecting hangers for piping subject to thermal movement is completely simplified. Grinnell Pre-Engineered Spring Hangers are available in stock sizes for any load requirement.

Simply compute the load and order the proper size Grinnell Pre-Engineered Spring Hanger as indicated in the Capacity Table appearing in descriptive catalog. 14 sizes with load range from 84 lbs. to 4,700 lbs.



Showing reverse application of Spring Hangers on a flexible piping support.

Flexible suspension of piping in one of world's largest catalytic cracking plants.

LOOK AT THESE FEATURES . . .

- **The maximum variation in supporting force per ½" of deflection is 10½% of rated capacity—in all sizes.**
- **Guides prevent contact of coils with casing wall or hanger rod and assure continuous alignment and concentric loading of spring.**
- **Compact—minimum headroom made possible by precompression*.**
- **Precompression* assures operation of spring within its proper working range where variation in supporting force is at a minimum.**
- **All-steel welded construction meets pressure piping code.**
- **14 sizes available from stock—load range from 84 lbs. to 4700 lbs.**
- **Easy selection of proper sizes from simple capacity table.**
- **Installation is simplified by integral load scale and travel indicators.**
- **Unique swivel coupling provides adjustment and eliminates turnbuckle.**

Precompression is a patented feature

Write for descriptive folder on Pre-Engineered Spring Hangers Fig. 268.

GRINNELL COMPANY, INC.
Providence 1, R. I.

Branch Warehouses

Atlanta 2, Ga.	Kansas City 16, Mo.	Philadelphia 34, Pa.
Charlotte 1, N. C.	Long Beach 10, Cal.	Sacramento 14, Cal.
Chicago 9, Ill.	Los Angeles 13, Cal.	St. Louis 10, Mo.
Cleveland 14, O.	Milwaukee 3, Wis.	St. Paul, Minn.
Cranston 7, R. I.	Minneapolis 15, Minn.	San Francisco 7, Cal.
Fresno 1, Cal.	New York 17, N. Y.	Seattle 1, Wash.
Houston 1, Tex.	Oakland 7, Cal.	Spokane 15, Wash.

GRINNELL
FOUNDED 1850
WHENEVER PIPING IS INVOLVED

CLEAN, SIMPLE, EFFICIENT...

Location:

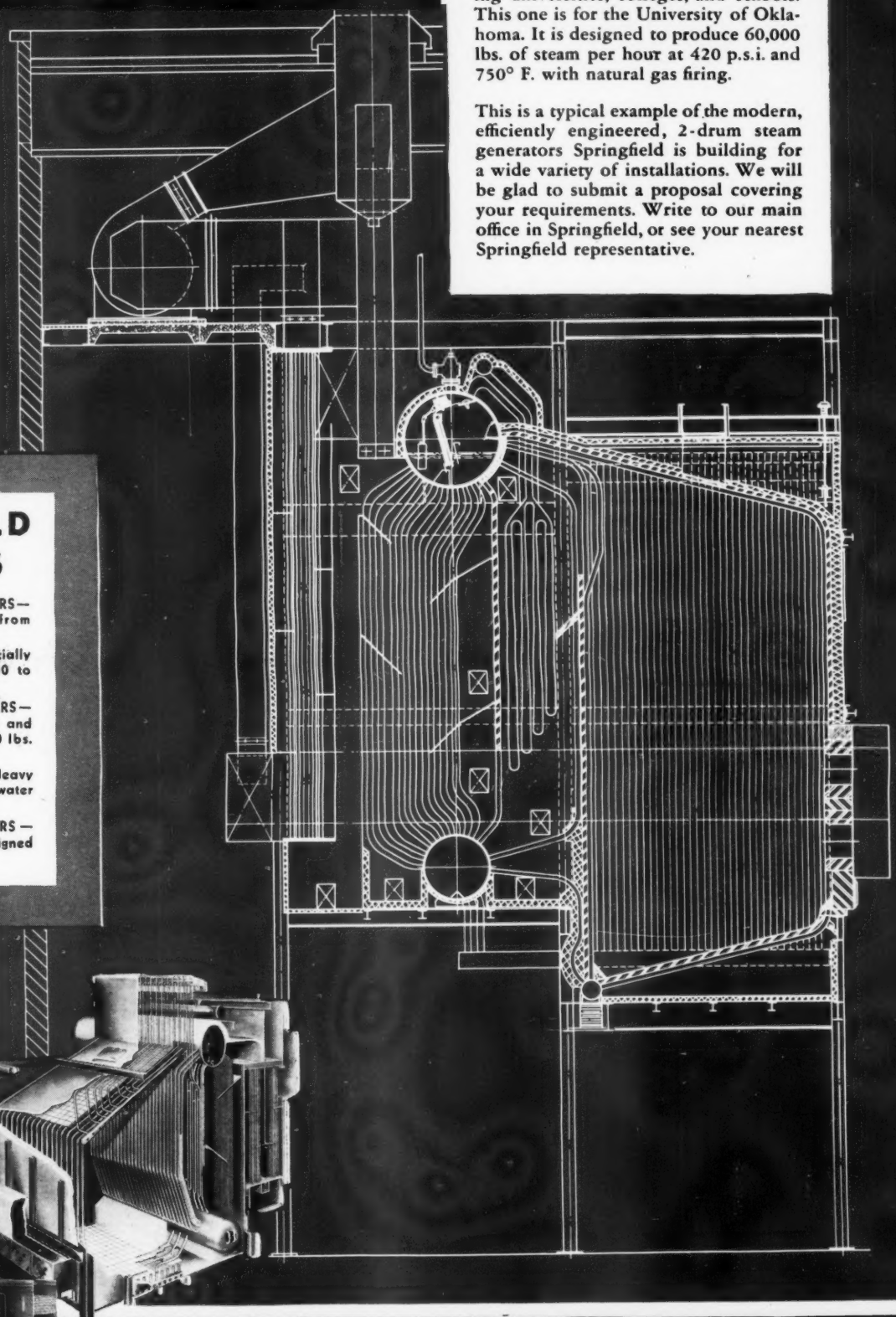
NIVERSITY OF OKLAHOMA
Norman, Okla.

Consulting Engineers:

COSTON & FRANKFURT
Oklahoma City, Okla.

SPRINGFIELD boiler designs have been the choice of numerous leading universities, colleges, and schools. This one is for the University of Oklahoma. It is designed to produce 60,000 lbs. of steam per hour at 420 p.s.i. and 750° F. with natural gas firing.

This is a typical example of the modern, efficiently engineered, 2-drum steam generators Springfield is building for a wide variety of installations. We will be glad to submit a proposal covering your requirements. Write to our main office in Springfield, or see your nearest Springfield representative.



SPRINGFIELD PRODUCTS

BENT TUBE STEAM GENERATORS—Modern designs for capacities from 10,000 lbs. up.

STRAIGHT TUBE BOILERS—Specially designed for capacities from 5,000 to 450,000 lbs. per hour and higher.

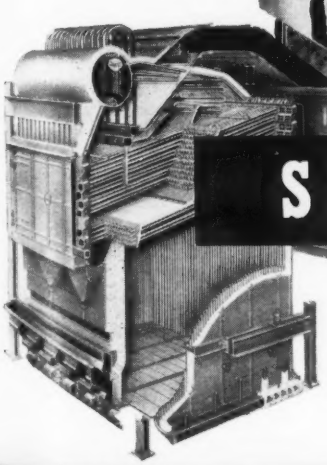
STANDARDIZED TYPE M BOILERS—Standardized for quicker delivery and lower cost. Sizes 6,000 to 17,000 lbs. per hour.

WATER COOLED FURNACES—Heavy duty water walls. Exclusive center water wall construction for larger units.

SUPERHEATERS — AIR HEATERS — ECONOMIZERS—Individually designed to meet requirements.

SPRINGFIELD BOILERS

CHECK WITH YOUR CONSULTING ENGINEER ON YOUR MODERNIZATION AND NEW PLANT PROJECTS.



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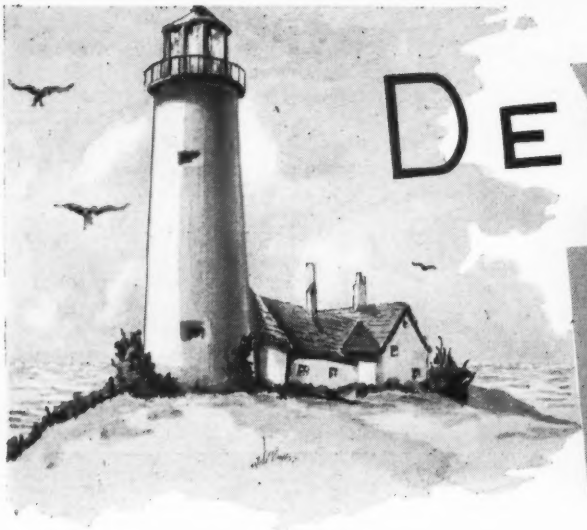


DEPENDABLE VALVES

to safeguard *flow control services* in all industries

Fig. 1793—Large 125-pound Iron Body Bronze Mounted Gate Valve. Made in sizes 2″ to 30″, inclusive. Has outside screw rising stem, bolted flanged yoke and tapered solid wedge. Tapered double wedge can be provided in sizes 2″ to 12″, inclusive.

Fig. 11323 W. E.—Class 1500-pound Cast Steel Flangeless Bonnet Gate Valve with welding ends. Has top-mounted electric motor operator for quick, positive opening and closing by remote control.

POWELL

Just as mariners depend on lighthouses to safeguard their ships, so the men of industry depend on their flow control equipment to safeguard their manufacturing plants from "going on the rocks" of costly shut-downs.

With a background of more than a century of making valves —and valves only—Powell Engineers know how to make a valve dependable.

And because today the Powell Line is so *complete*, there are Powell Valves of all types—in Bronze and Iron, or Cast Steel in pressure classes from 150 to 2500 pounds—specifically designed and made to give long, dependable performance in every service in the modern power plant.

It pays to consult Powell Engineers on all your requirements for flow control equipment.

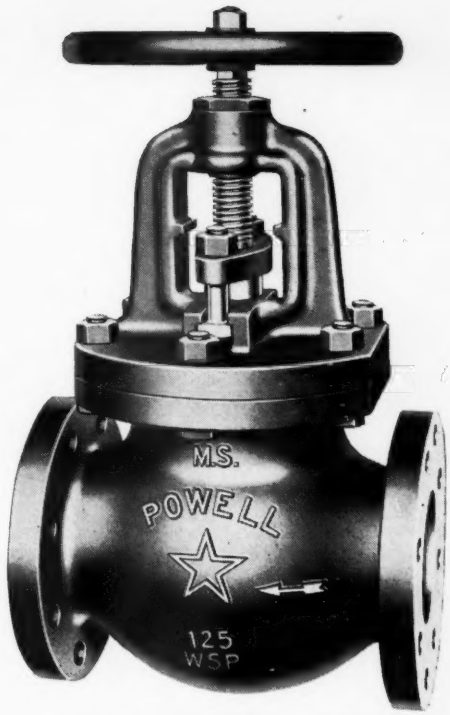


Fig. 241—Large 125-pound Iron Body Bronze Mounted Globe Valve. Made in sizes 2" to 16", inclusive. Has outside screw rising stem, bolted flanged yoke and regrindable, renewable bronze seat and disc.

Fig. 6061 W. E.—Class 600-pound Cast Steel Swing Check Valve with welding ends and bolted cap. Disc has ample lift to permit full straightway unobstructed flow through the valve body.

Fig. 19084 W. E.—Class 900-pound Cast Steel Flangeless Bonnet Welding End Non-return Globe Valve. Has compound spur gearing to provide easy operation. Stellite faced.

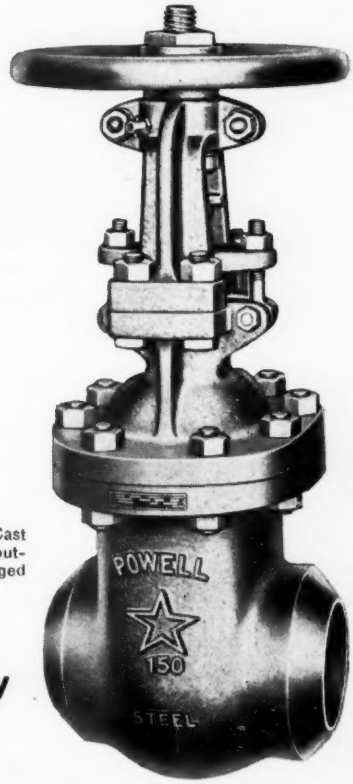


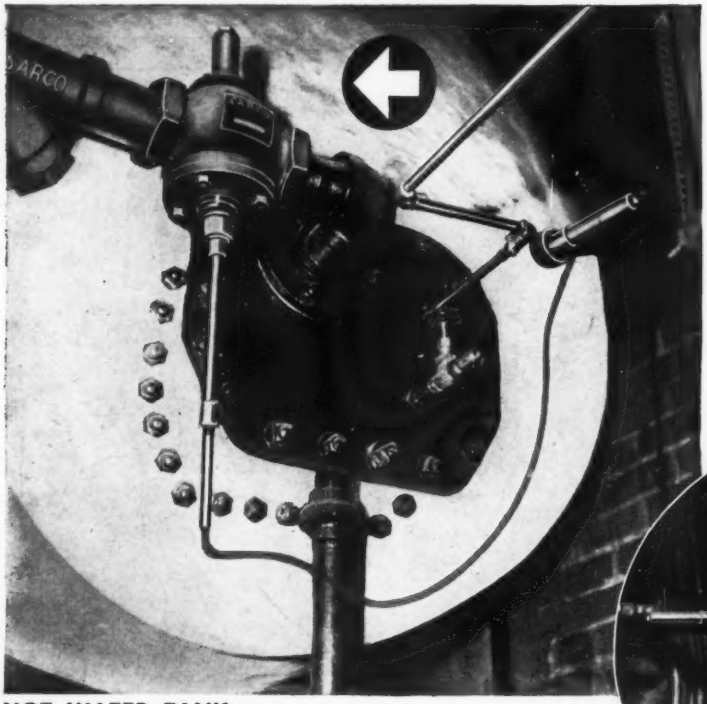
Fig. 1503 W. E.—Class 150-pound Cast Steel Gate Valve with welding ends, outside screw rising stem, bolted flanged yoke and tapered solid wedge.

The Wm. Powell Company

Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

VALVES



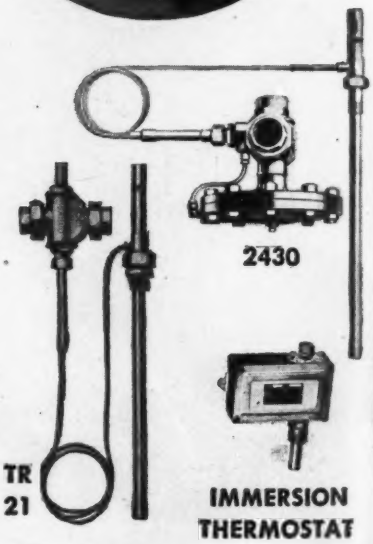
HOT WATER TANK

Why the Best HOT WATER SERVICE *Costs Less!*

STORAGE TANK

BLENDED WATER

MB BLENDER



2430

TR 21

IMMERSION THERMOSTAT

It's not a luxury to have all hot water services Sarco Temperature Controlled. In fact, on most jobs, the controls pay for themselves in four ways.

1. Automatic control prevents overheating — fuel is saved
2. "Never too hot, never too cold," increases quality and quantity of output in heat processing
3. Blending of water for showers and wash basins increases hot water storage capacity
4. Everything works, 24 hours a day, without shut-downs or complaints.

In a factory, a service tank was controlled for twenty-four years at a cent a day. A mine saved hundreds of dollars by installing Sarco Blenders for showers, and dish washing.

What would Sarco Temperature Controls save in your plant? Why not ask the Sarco Man near you?

241

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SAVES STEAM

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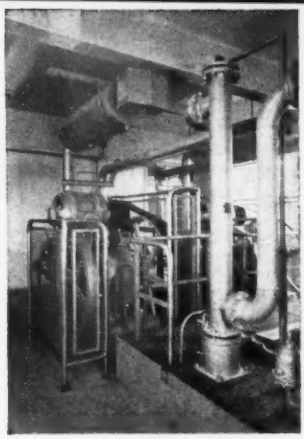
View of Coty plant at Suresnes, France



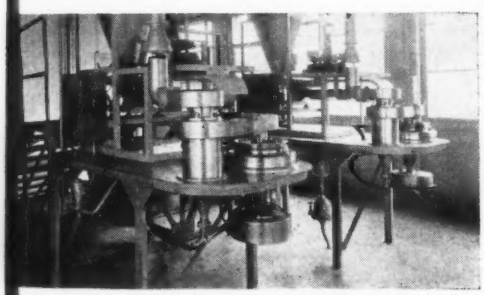
Rear view of Worthington Compressors, showing Multi V Drive aftercooler and receiver.

These Machines Put the Air in "Air-Spun" Face Powder

a number of years, Coty, Inc. (Societé TY), in its plant at Suresnes, France, has d air-actuated micronizers to provide the h degree of fineness and smoothness that racterizes Coty's "Air-Spun" face powders. oty pioneered in this development of sup- menting mechanical methods of processing ingredients with this method which causes mechanically-processed materials to im- ge against each other, effecting extremely nute pulverization.

arefully metered volumes of compressed are delivered at 95 psi to the micronizers, ere directional air nozzles create intensive diverse swirls, producing the desired verization.

o provide oil- and moisture-free com- ssed air, Coty selected Worthington com- ssors, 12 x 11 machines rated at 95 psi, 0 cfm, and 25 rpm, driven by 50 hp, 1200 n motors.



Micronizers in Coty plant. Air fed through directional nozzles causes powder particles to impinge against each other, producing minute pulverization. Particle size is controlled by rate of feed.

Special Features

order to reduce vibration and noise to a nimum, the compressors were specially- ilt. Aluminum, rather than cast-iron, pistons duced inertia and resultant unbalanced shak- g forces. Placing the motor nearer the crank d of the machine brought the center of avity into a more favorable location in spect to the foundation.

o prevent the machines from operating in nchronism for any length of time, sheave ameters were modified slightly, giving a mpressor speed of 250 rpm for No. 1 unit, 5 rpm for No. 2 unit, and 240 rpm for No. 3 it. Although two machines could at some me, be in step, synchronism would be instan- taneous only. Adjacent compressors on the same center line were installed opposed, as a further compensation for unbalance.

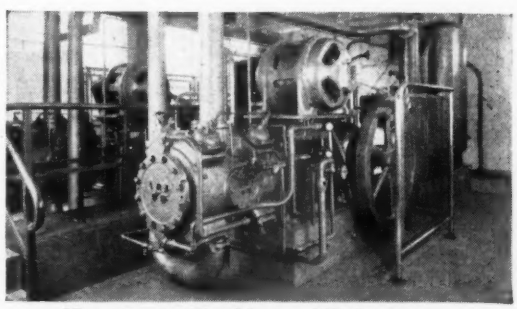
Sensitive Mercoid pressure switches, actuated by air-receiver pressure, are set for slightly different pressures so only those compressors required to meet air demands will operate. No. 1 pressure switch opens at 100 and closes at 95 psi; No. 2 pressure switch opens at 99 and closes at 94 psi; No. 3 pressure switch opens at 98 and closes at 93 psi; and No. 4 pressure switch opens at 97 and closes at 92 psi.

Timing

The timing relay, actuated by a small subsynchronous motor, provides a delay between the energizing of any two motor starters, preventing second motor from starting until the first is running with the compressor fully loaded.

The four reset pushbuttons serve as cutout switches during weekend and shutdown periods. Also, they prevent the automatic restarting of any unit after it has been automatically shut down from causes such as loss of jacket cooling water or current failure.

Each compressor has its individual aftercooler and air receiver. Aftercoolers, somewhat oversize, provide a longer cooling time to give a maximum of oil and moisture separation. An automatic moisture trap expels oil and moisture separated in the aftercooler. A second trap removes further condensation and separation occurring in the receiver. Twin mechanical oil separators are installed just beyond the air receivers. To prevent discoloration difficulties the inside of the aftercoolers and receivers are galvanized, or covered with rust-proof paint; distribution-system piping and fittings are of brass.



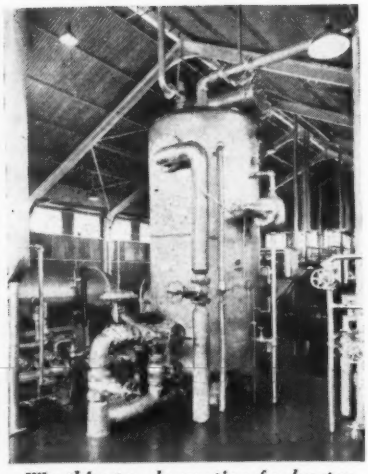
Two 12 x 11 Worthington HB Compressors which furnish air to the micronizers.

NEWS

FROM THE POWER FRONT

AS REPORTED BY THE DEVELOPMENT ENGINEERS, FIELD SERVICE REPRESENTATIVES AND CUSTOMERS OF WORTHINGTON

1

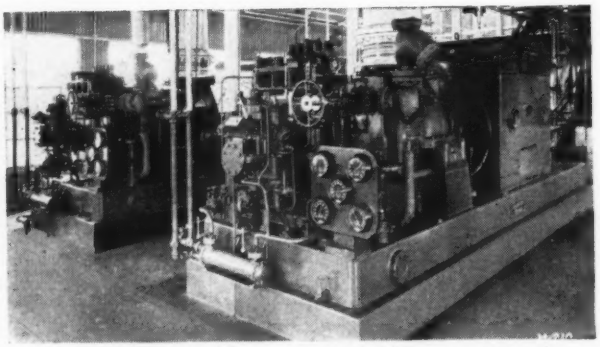


Worthington deaerating feedwater heater—90,000 lb. hr.

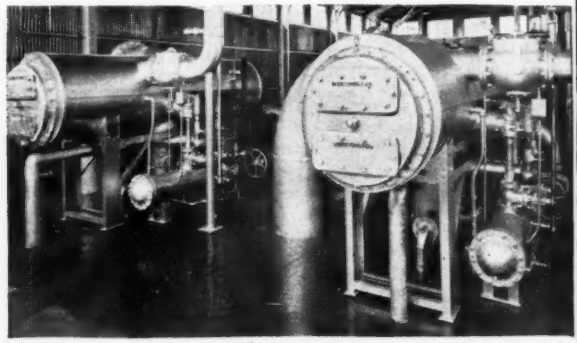
It Takes a Lot of Worthington Equipment to "Dry Out" Gas

These pictures show some of the Worthington equipment installed in The Chicago Corporation's Feazel & Kinsey gasoline plant located at Carthage, Texas, designed and built by Stearns-Roger Manufacturing Co. of Denver.

The purpose of this plant is to take the wet high-pressure gas produced from the high-pressure gas wells in the Panola County fields, and separate the water vapor from the recoverable hydrocarbon vapors consisting primarily of propane, butane, and gasoline. The residue dry gas leaving the absorbers is delivered to the pipe line for transmission and distribution.



Two 750 KW Worthington steam turbine-generator units



Two 800 sq. ft. Worthington surface steam condensers and condenser accessories

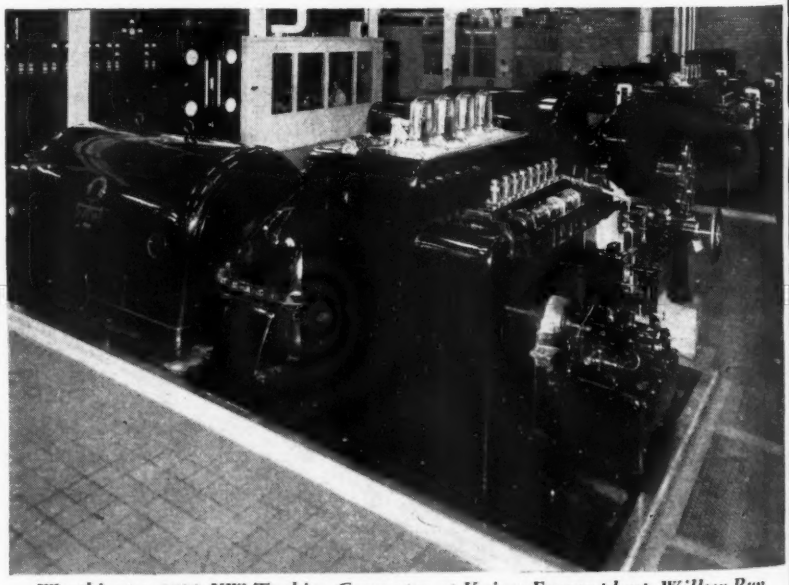
2

What Makes Willow Run Run?

Electric power for the Kaiser-Frazer plant at Willow Run, Michigan, is furnished by two Worthington 2500 kw Turbine-Generators.

These units are direct-connected, 3600 rpm, 13,800 volt, 3 phase, 60 cycle. They operate on steam at 250 lb initial pressure, 470 F total temperature, exhausted at adjustable pressures of 15-50 lb to a condenser of 27½ in. vacuum.

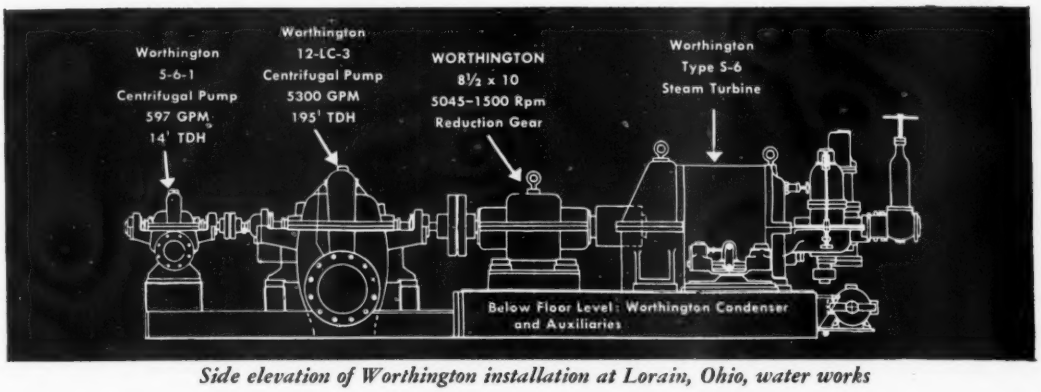
Installed in 1941, these Worthington Turbine-Generators supply both electric power and extracted steam for plant heating.



Worthington 2500 KW Turbine-Generator at Kaiser-Frazer plant, Willow Run

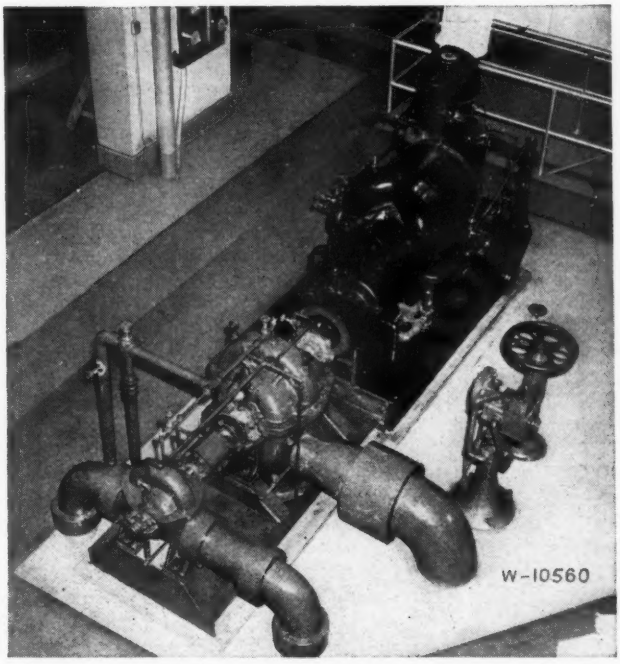
Worthington Pump and Machinery Corporation
Harrison, N. J.

NEWS



Side elevation of Worthington installation at Lorain, Ohio, water works

A Lot of Water Has Gone Through This Pump



Worthington Centrifugal Pump in water works at Lorain, Ohio

More than ten years ago, the city of Lorain, Ohio (a community of 45,000 people) installed a Worthington centrifugal pumping unit to deliver seven and one half million gallons of water per day.

H. B. Wallace, chief engineer of the water works, reported recently that this Worthington pump has operated continuously ever since with never a shutdown except for routine maintenance.

During the majority of the time the pump has handled the entire capacity load; and at various times it has been required to handle appreciable overloads.

The complete water works unit consists of a 7.5 mgd 12 in. pump that is driven by a geared steam turbine with the main pump shaft double extended for connection to the condenser circulating pump; also a surface condenser with its auxiliaries.

All elements are of Worthington manufacture, thus giving undivided responsibility for proper operation.

Springfield Purchases 3rd Worthington Turbine Generator Unit

The city of Springfield, Minnesota, has for a long time operated its own electric power plant.

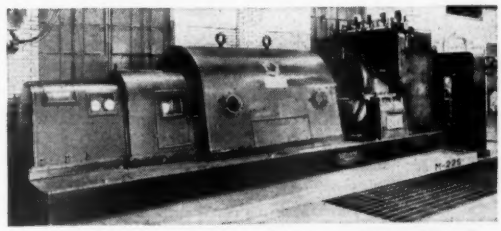
In 1895, electric power was furnished in a limited way from 5 to 10:30 P.M. each day by a 40 kw generator driven by gasoline engine. In 1902 a steam engine with 50 kw belted generator was installed. In 1915 this was replaced by a 100 kw steam engine, and the system was converted from direct current to alternating. At the same time a heating system for the business district was installed, using the exhaust steam which would otherwise be lost to atmosphere.

Further expansion came in 1923 with a 250 kw steam engine. By 1937 the electric load had so far outstripped the heating load that it became necessary to exercise economy in order to reduce cost of operation. A 750 kw Moore automatic bleeder condensing turbine was installed; it was designed for 400 lb steam pressure, 670 F temperature.

Then the necessity for adapting all the modern practices of steam plants — including higher pressure and temperature–led to the purchase of a 1000 kw Moore automatic bleeder condensing turbine.

Acquisition of REA power contracts necessitated further expansion of the facilities. Last year a 2000 kw Worthington automatic extraction unit was put into operation along with a new high pressure boiler.

The plant now realizes maximum efficiency from the advantages of modern design.



Worthington 2000 kw turbine generator, City of Springfield, Minnesota

OUT-OF-DOORS

Power plant equipment is out-growing the confines of the conventional "boiler house" these days. Building costs are a serious bar to expansion in many cases, while adjacent space is unavailable in others. Therefore any equipment that can be installed outdoors offers welcome relief to overloaded generating plants. Cochrane Deaerators and Deaerating Heaters can be designed to suit practically any space requirement indoors, and when indoor space is not available, may be installed outside, as shown in the photographs on the opposite page. Suitably lagged, these may be installed outside in any but the coldest climates with no impairment of operation.

(upper left) Cochrane Deaerator and Horizontal Storage Tank installed outside plant of Millville Mfg. Co., Millville, N. J.

(upper right) 220,000 lb/hr. Cochrane Metering Deaerator mounted on roof of Scott Paper Co. plant, Chester, Pa. Storage tank is located inside building on floor below.

The extreme flexibility of Cochrane design as well as the inherent efficiency of the Cochrane principle of deaeration make it the most popular equipment for the protection of boiler plants against corrosion due to oxygen-bearing feedwater.

Many illustrations similar to these as well as more conventional installations are shown in Cochrane Publication No. 3005. A copy will be sent to anyone interested.

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1863 - 1948

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COCHRANE

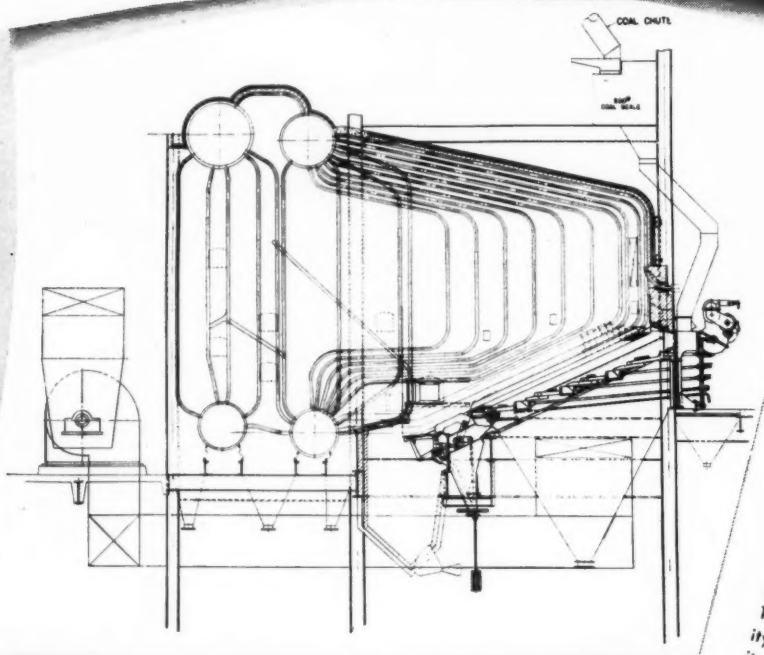
DEAERATORS and DEAERATING HEATERS

75,000 lb/hr. Cochrane Metering Deaerator installed outside boiler plant, in courtyard of Philadelphia's City Hall.

(above)
900,000 lb/Cochrane Atomizing Deaerator, mounted on horizontal storage tank at plant of Socony-Vacuum Oil Co. at Paulsboro, N.J.

(center)
Two Vertical Cochrane Deaerators located at Rio de Janeiro, Brazil.

Here's the Stoker for: **LOWER POWER COSTS**
FREEDOM FROM STACK NUISANCE
MAXIMUM FUEL FLEXIBILITY



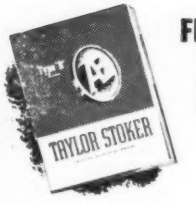
Recent Installation Burns Low Grade Fuels

A large Eastern manufacturing plant uses a Taylor Multiple Retort, Underfeed Stoker with continuous ash discharge. The unit operates continuously at 125,000 lbs. per hour although designed for 105,000 lbs. per hr. Designed to burn bituminous coal with 16% ash content and heating value of 12,800 BTUs per lb., it recently handled strip mine coal having only 10,000 BTUs per lb., proving its ability to burn low grade fuels and carry its rated capacity.

Taylor is the stoker that beats the high cost of fuels. It has been proved in installation after installation that Taylor Stokers permit the use of a wide variety of type and sizes of fuels. You can feed the Taylor Stoker any kind of coal that's convenient to you . . . for price, labor, delivery and mine location.

Taylor's precision control feed mechanism and better air flow means thorough combustion, maximum fuel economy, and *freedom from stack nuisance.* Simplified construction results in fewer moving, longer-wearing parts, higher operating efficiency, and lower boiler outages. These and many other exclusive features combined add up to efficient, low-cost steam production.

Get more information about the flexible, versatile Æ Taylor Stoker now. Write to us today for literature and engineering help. Ask us to make recommendations—no obligation.



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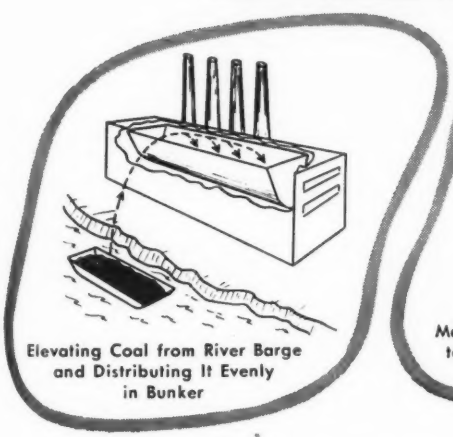
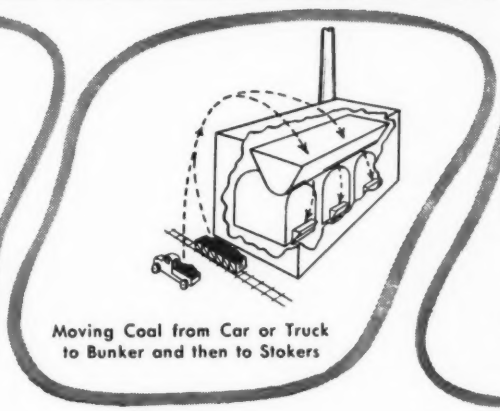
with Bulk Material Handling—

S-A "KNOW-HOW" Can Do You a Real Service!

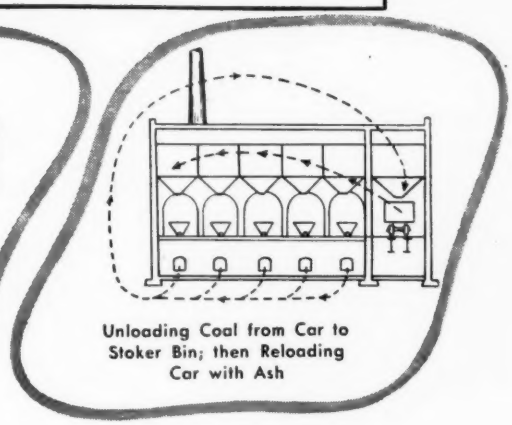
Every Day, S-A Solves Situations Like These — and Many Others!



Elevating Coal from River Barge and Distributing It Evenly in Bunker



Moving Coal from Car or Truck to Bunker and then to Stokers



Unloading Coal from Car to Stoker Bin; then Reloading Car with Ash

No matter what your bulk material handling problems may be, the right engineering "know-how" assures your getting the right equipment for a more efficient job—at lower cost per ton. S-A engineers, with 47 years' experience solving every type of problem on the job, are well qualified to help you.

S-A engineers can frankly suggest the best system for your specific need, because they don't have to solve every problem with one type of equipment. They have the *complete* S-A line of belt conveyors, bucket elevators, Redlers, skip hoists and other equipment to choose from. Ask us to show how we can help you, *today!*

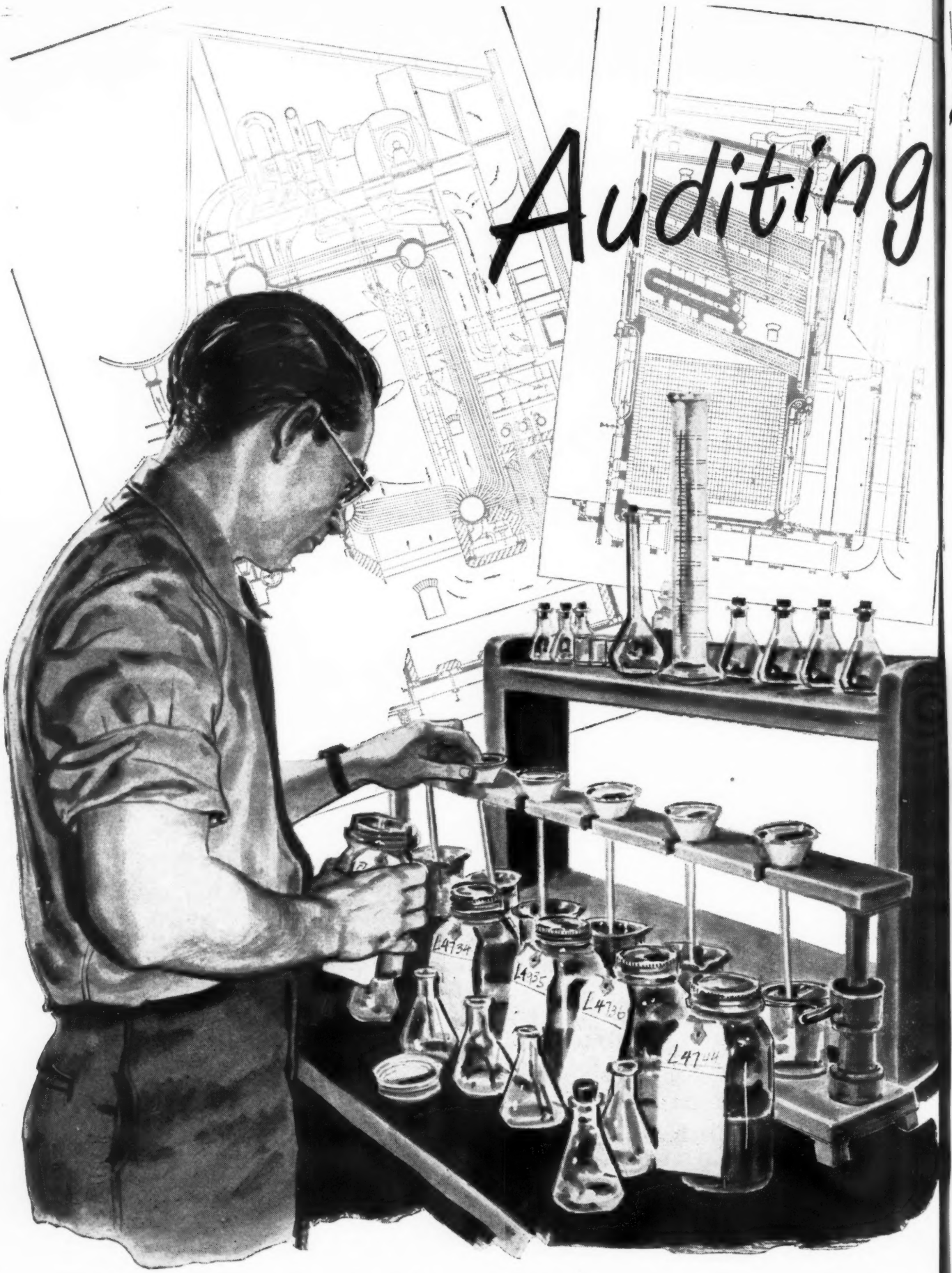
STEPHEN S-A DAMSON MFG. CO.

5 RIDGEWAY AVENUE, AURORA, ILLINOIS ★ LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

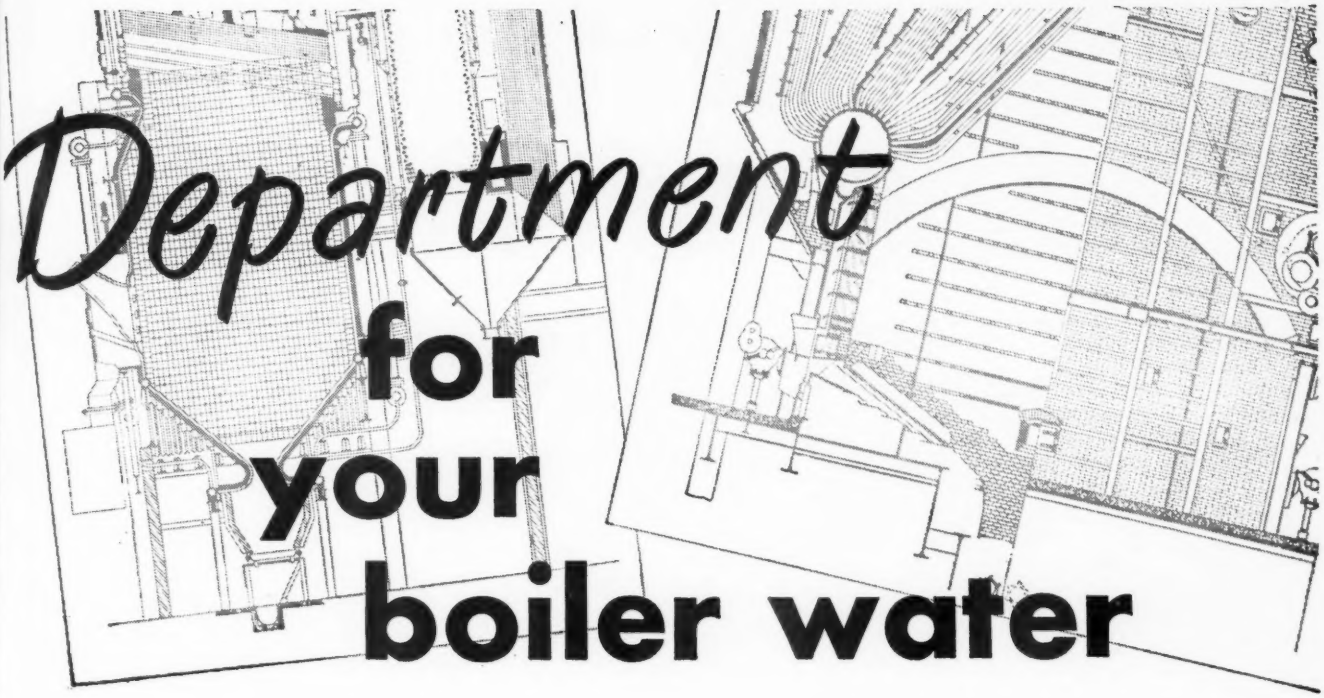
Designers and Manufacturers of All Types of

BULK MATERIAL HANDLING EQUIPMENT

Auditing



Filtering samples of boiler water. Thorough removal of suspended solids is an essential first step in many testing procedures.



Department for your boiler water

One part of the service of Hall Laboratories is the periodic analysis of samples of boiler water and other waters from the plants of its clients, and checking these against analyses made by plant personnel for day-to-day control. The usual result of this "auditing" is assurance that proper conditions are being maintained—but in some instances it prevents possible trouble or ends needless expense.

Testing for organic matter, for example, may show the presence of oil—which would not be detected by the usual tests at the plant—and thus enable the plant to stop oil contamination before it causes serious trouble.

Or we may find that reserve phosphate in the water is considerably less than is shown by plant tests. A quick warning goes to the operator, together with the suggestion that he see if the calcium phosphate sludge is being thoroughly removed before samples are tested.

Again, we may find that reserve phosphate is unnecessarily high—which may mean that phosphate is being wasted or that tests are being made with a weak molybdate solution instead of the recommended reagent.

Our files contain hundreds of similar examples showing the value of the *continuing service* given by Hall Laboratories to plants of all sizes, in all parts of the country. Every problem concerning the industrial use of water comes within the scope of Hall service, and correspondence concerning your problems is invited.

Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

HALL LABORATORIES, INC.

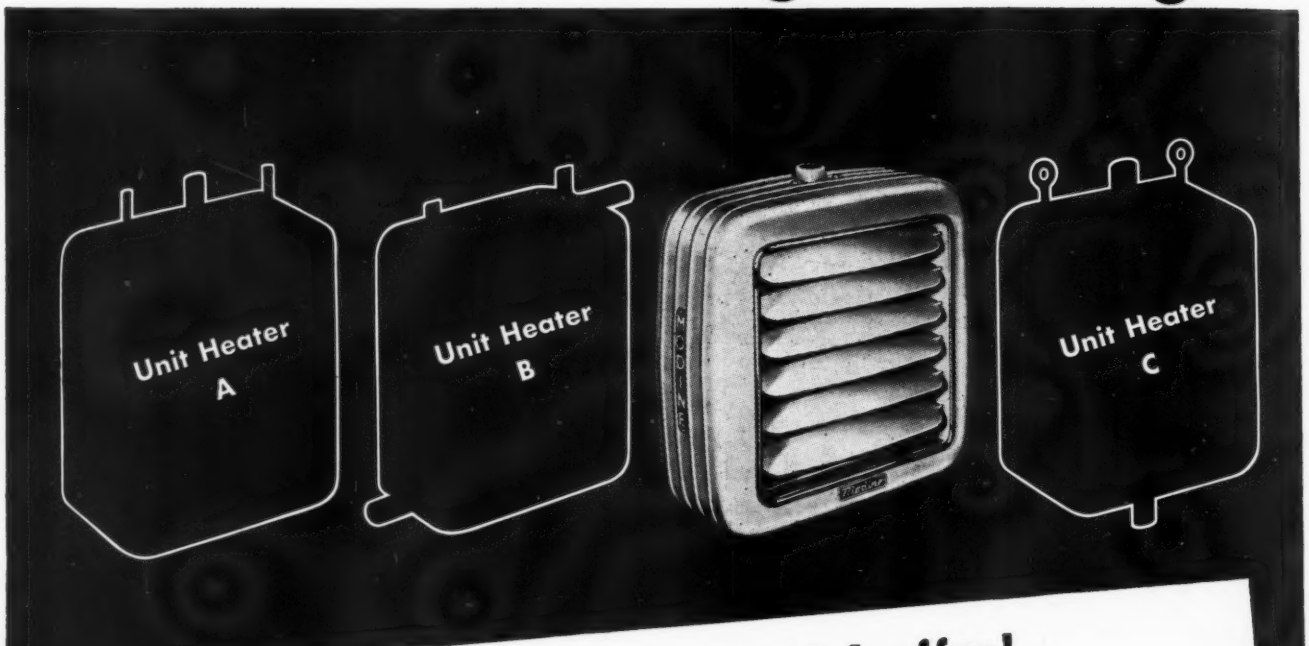
(A Subsidiary of Hagan Corporation)

CONSULTANTS ON
INDUSTRIAL WATER TREATMENT
HALL SYSTEM OF BOILER WATER CONDITIONING
INDUSTRIAL WASTE RECOVERY AND DISPOSAL

HAGAN HALL BUROMIN CALGON

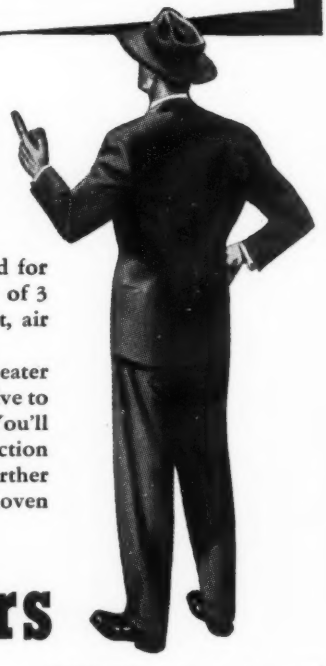
To everyone about to order unit heaters, Modine says,

"Look before you buy!"



Modine makes this Special offer!

Your Modine Representative is ready to show you an actual production model of a Modine Unit Heater for your personal examination. Note its attractive appearance, sound engineering, rugged construction. Modine suggests you make a similar examination of other unit heater makes before you buy!



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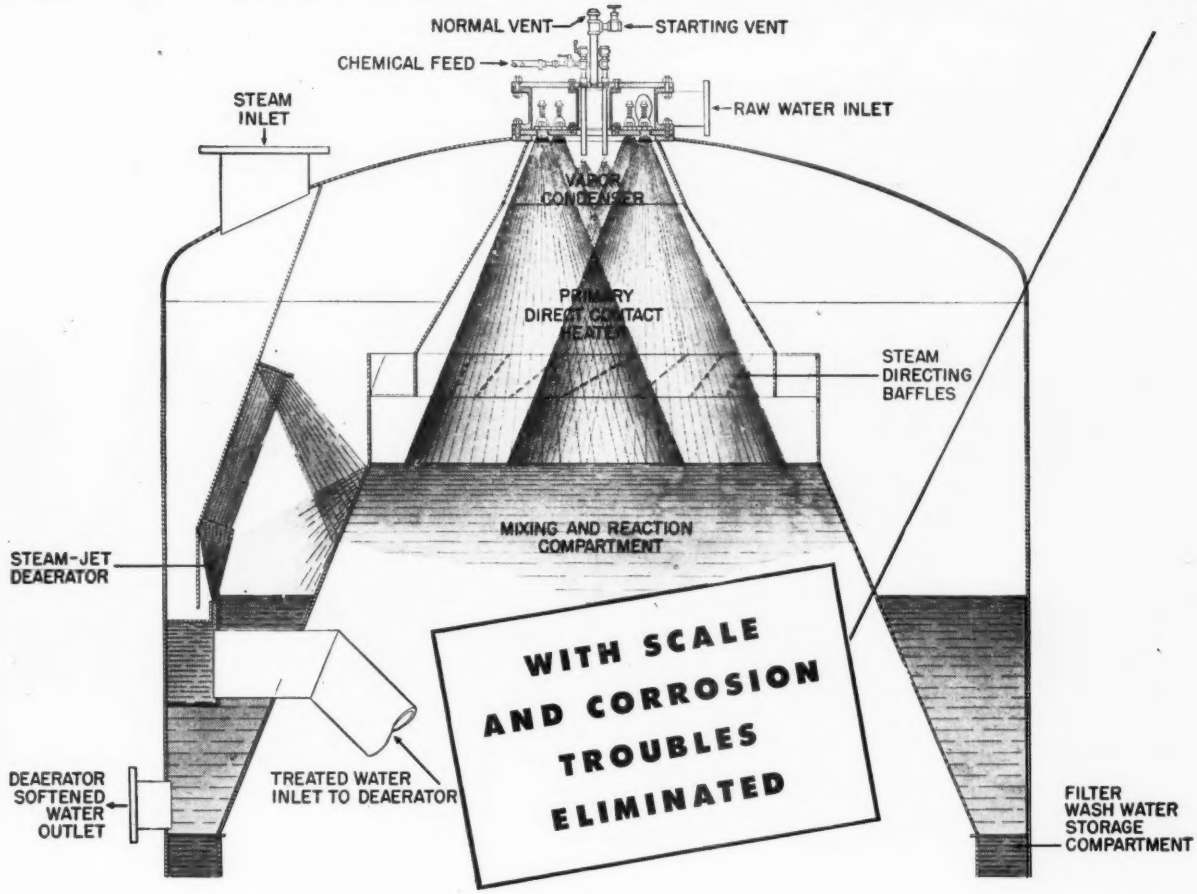
Modine Unit Heaters

NOW...water softening



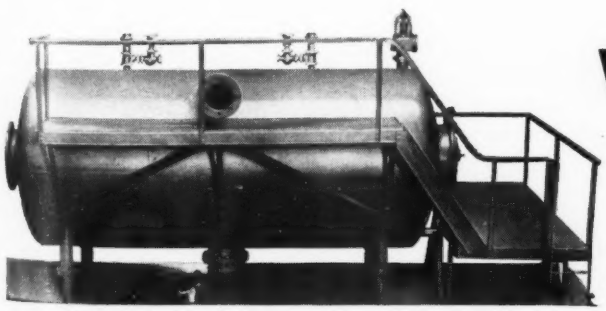
The tubular vent condenser which Worthington Research and Engineering previously eliminated on deaerators is now no longer a necessary part of the water softener!

Worthington research has developed a hot process deaerating softener in which the displacement flow path for steam is so designed that non-condensibles are separated from the water and concentrated for removal with negligible thermal loss—*without the need of tubular vent condenser.*

This means: no more scaling and corrosion of tubes, water inlet piping and spray valves . . . no more loss of operating efficiency due to scale . . . no more maintenance costs for scale removal.

It's another Worthington achievement in water softening which . . . like the already-established filter wash water storage compartment . . . proves again that *there's more worth in Worthington!*

Write for further information on Worthington Water Softeners and Deaerators, addressing nearest district office or Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, N. J.

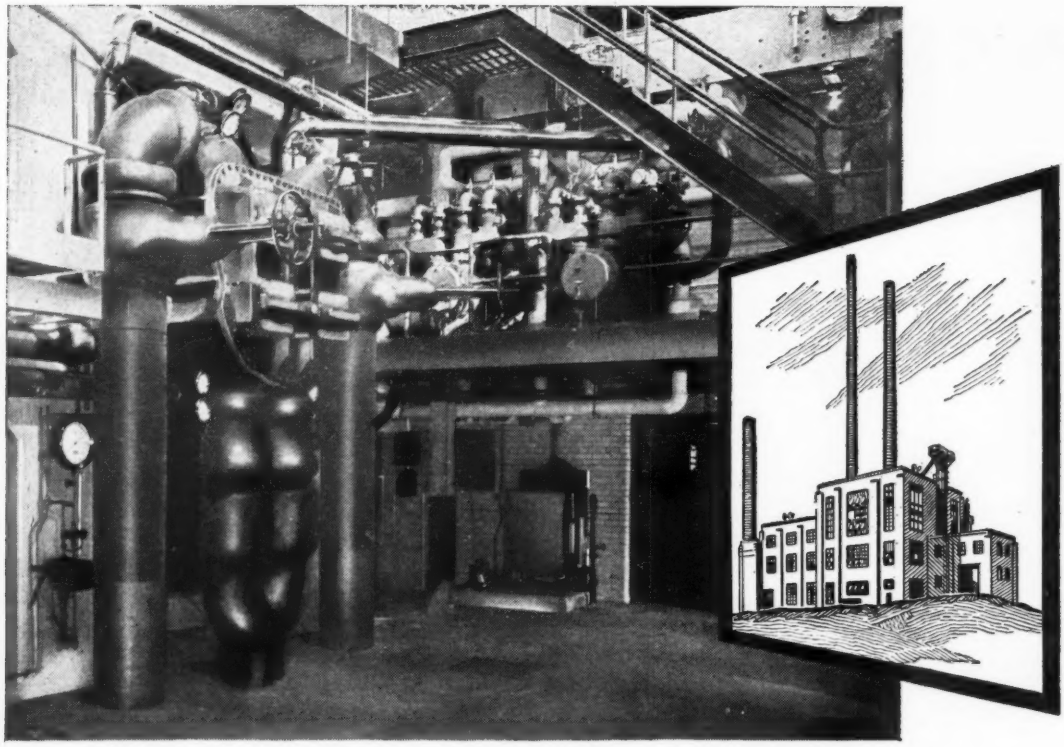


A Worthington deaerator *without vent condenser*

WORTHINGTON

WATER SOFTENERS

JB-2



CITY OF DOVER, OHIO

installs second I-R Condenser

The power plant of the City of Dover, Ohio is an excellent example of the way smaller power plants throughout the country are keeping up with the ever growing demand for power. With the recent addition of a new 4000 kw turbo-generator and Ingersoll-Rand condensing plant, the City of Dover has completed one more step in a long-term expansion program. The new unit was installed under the jurisdiction of W. C. Kammerer and Associates, Consulting Engineers, Cleveland, Ohio and Mr. Waldo Hartline, the City Engineer. The condenser is an Ingersoll-Rand two-pass unit, vertically divided so that one half of the condenser can be operated while the other half is down for inspection or cleaning. In this plant there is also a 2000 kw I-R condenser, installed in 1938, three motor driven circulating water pumps, two boiler feed pumps, four condensate pumps and an air compressor for plant air.

By selecting Ingersoll-Rand condensers, pumps and auxiliaries, the City of Dover has received the benefit of the very latest developments in condenser plant design. If you are planning to expand your present power generating facilities, call in an Ingersoll-Rand specialist. He can show you the latest Ingersoll-Rand developments.

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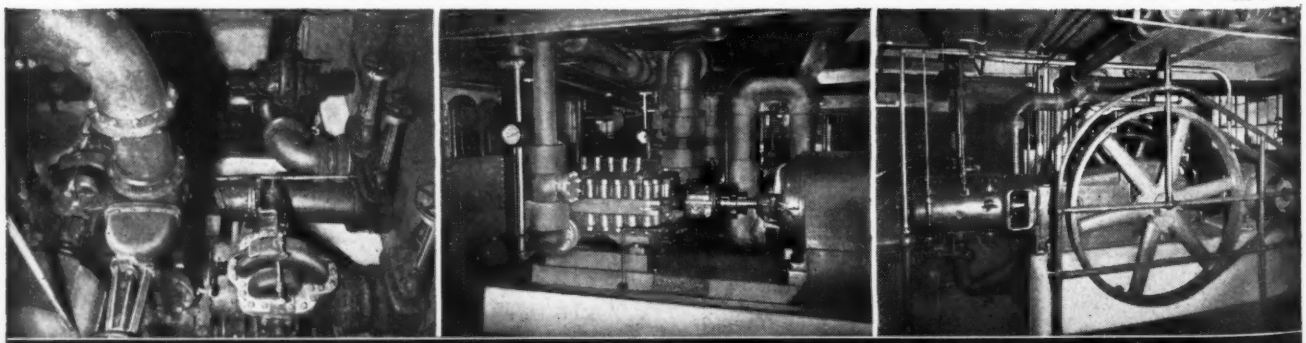
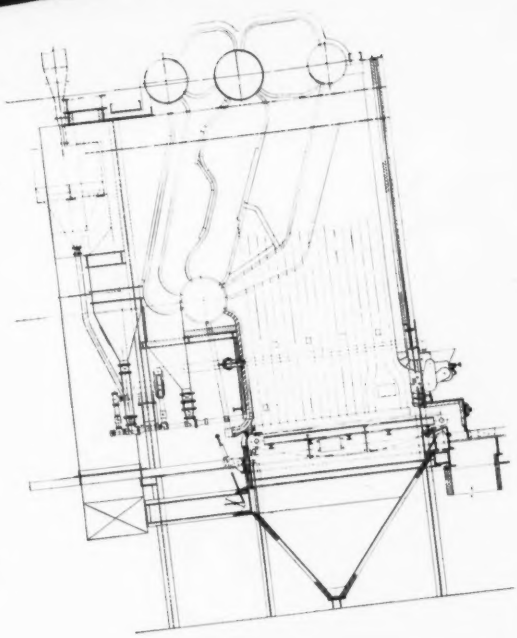
213-4



Maximum Combustion Efficiency at MINIMUM COST

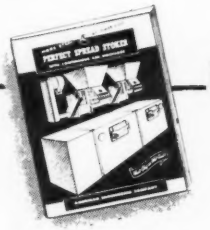


● *This installation at the Eastern plant of a national rubber company consists of an Æ Perfect Spread Stoker with Continuous Ash Discharge, with 183 sq. ft. grate area. Installed under a Babcock & Wilcox boiler with 6900 sq. ft. of heating surface, this unit is equipped with an air heater for 300° air temperature. Designed to handle increased requirements of the plant, this stoker is capable of delivering 60,000 lbs. per hour steam output using lower grades of strip coal . . . an important economy which will result in savings year after year.*

With the Æ Perfect Spread Stoker you're able to burn a wide variety of fuels—even the cheaper or lower grades of coal—and be assured of highly efficient, consistently thorough combustion.

Whether you're now hand-firing your boilers or want to replace old, inefficient equipment you'll appreciate the exclusive Æ advantages that mean completely dependable steam generation at low operating cost. Take the Continuous Ash Discharge feature for example . . . this traveling grate system provides entirely automatic removal of ash, eliminates periodic dumping of grates and cleaning of fires thus maintaining top efficiency at all times. Then too, this compact, economical stoker operates smoothly, perfectly even on wet, damp or partially frozen coal—without clogging.

Find new freedom from fuel worries and maintenance problems with an Æ Perfect Spread Stoker in *your* boiler room. Write for descriptive booklet today!



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For full details write for Bulletin 46-605—contains schematic drawings of 14 typical installations.

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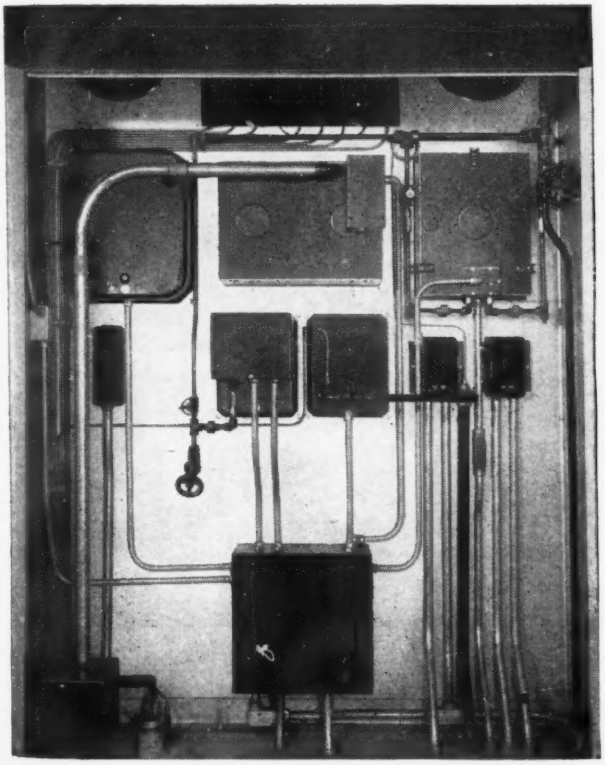
Michigan City, Indiana



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4. **For all sizes of steam generating systems burning *any kind of fuel.***
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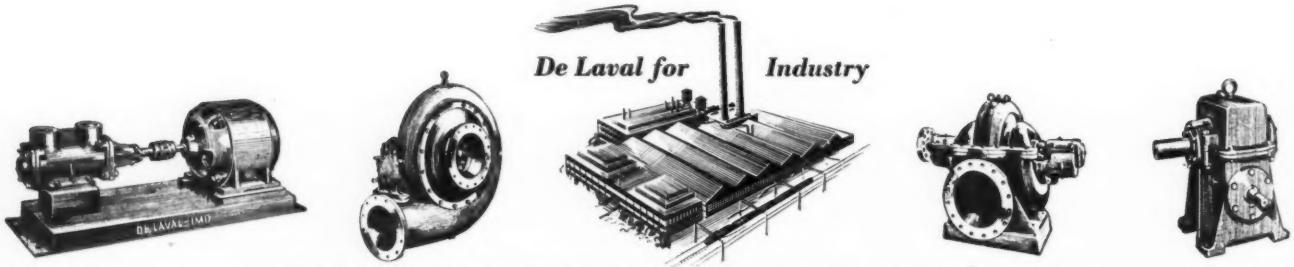

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SEPTEMBER 1948 VOLUME 92, NUMBER 9

A CROSS-INDEX OF SUBJECTS FOR THE MONTH

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STEAM GENERATION, FUELS, FIRING AND COMBUSTION
TURBINES, ENGINES, AUXILIARIES; HYDRO POWER
DIESELS, GAS ENGINES AND ACCESSORIES
AIR CONDITIONING AND REFRIGERATION
ELECTRICAL EQUIPMENT, ELEVATORS
PIPING, VALVES AND SPECIALTIES
TRANSMISSION, LUBRICATION
STEAM SERVICES, HEATING
INSTRUMENTS, CONTROLS
PUMPS, COMPRESSORS

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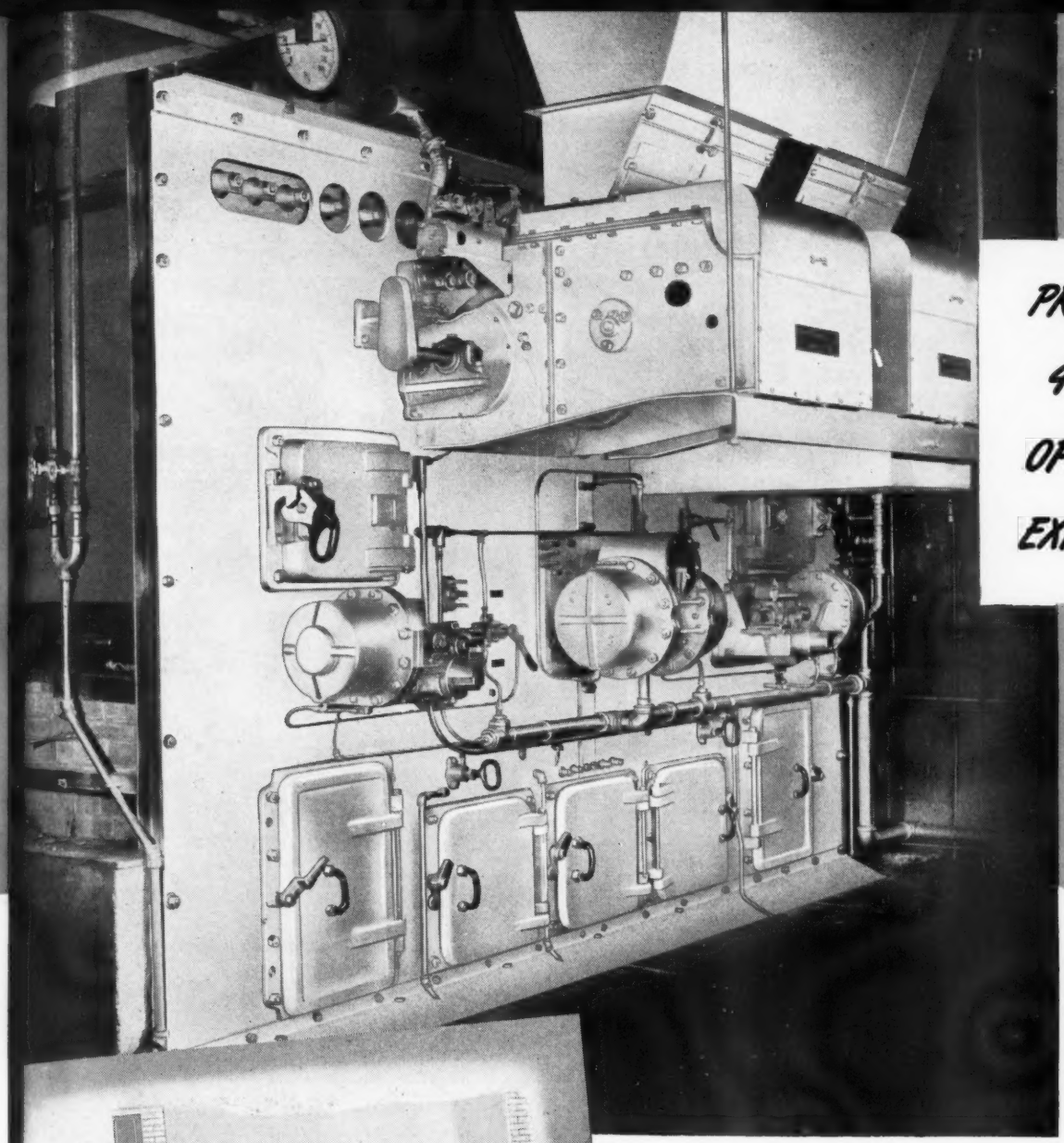
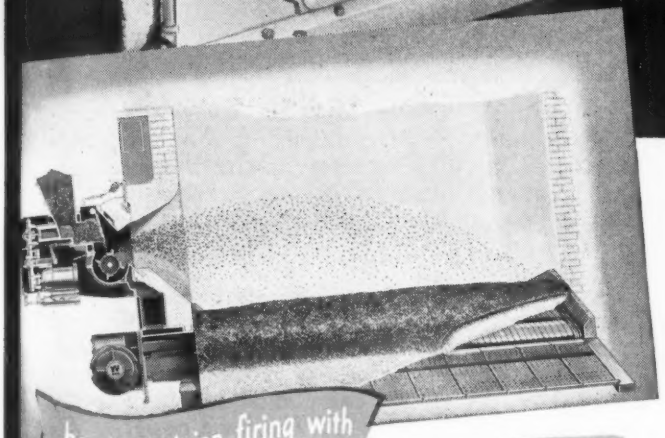


PROVED BY 4 YEARS OPERATING EXPERIENCE

Four years of operating experience has resulted in the design and construction refinements exemplified in this year-old installation of American Home Foods, Inc.



here's precision firing with maximum fuel combustion

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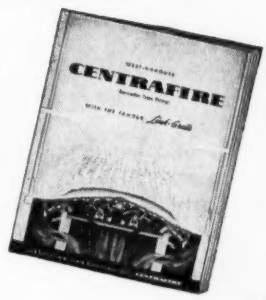

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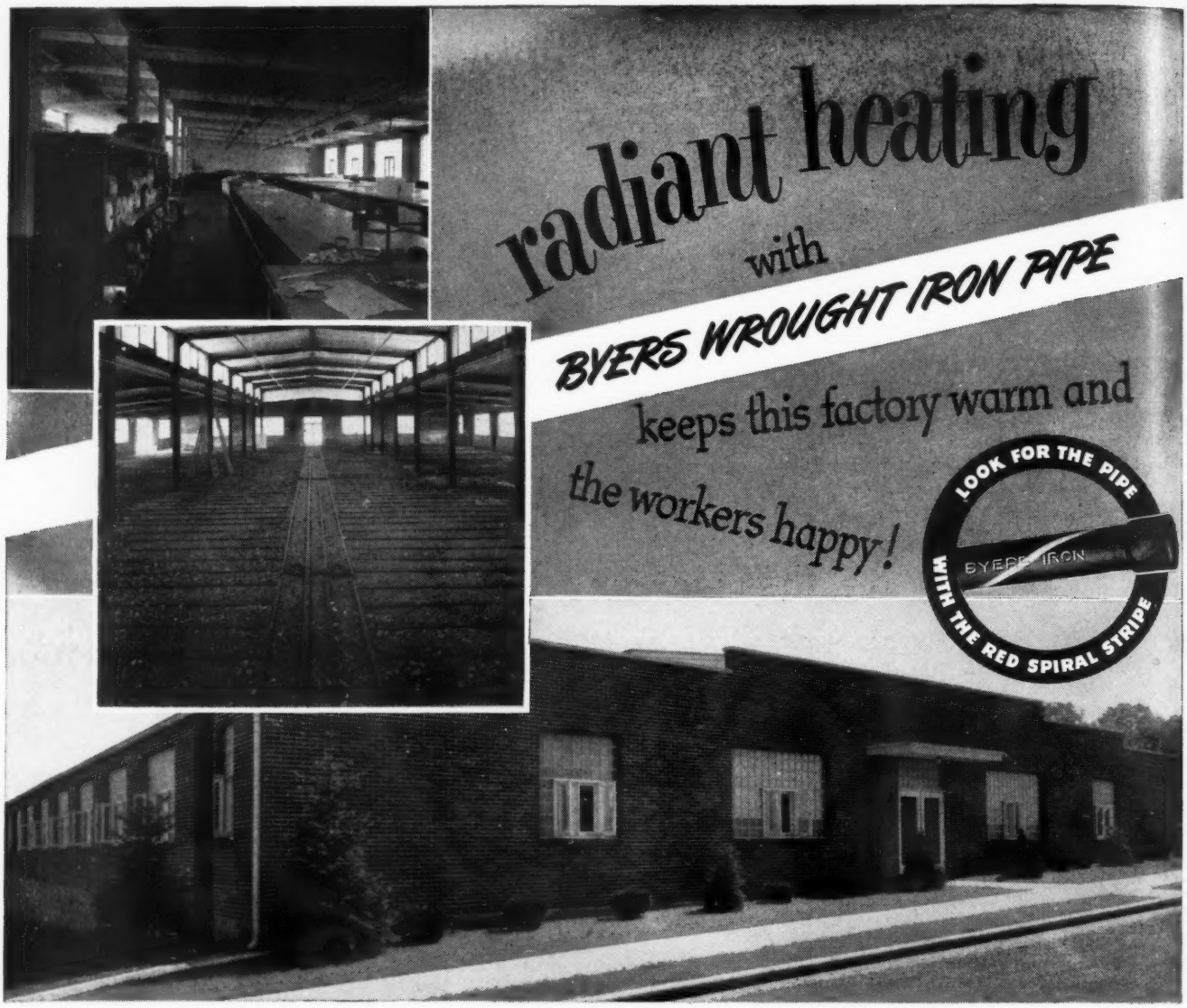

The "New Look" that modern design gives to today's industrial structures has a parallel in the new look that management is giving to features affecting working conditions. In the rayon underwear factory of Campbell & Helmich, Inc. at Boyertown, Pa., the owners recognized the dollar value of employee comfort, and specified radiant heating, using Byers Wrought Iron pipe for the floor coils. The system was designed by Carl M. Snyder of Corbits, Inc., and installed by Warren F. Smith, heating contractor.

RESULTS EXCELLENT

The owner reported some very interesting results. Not one complaint regarding colds and drafts was registered. Even in midwinter, the "head-level" temperature was not stuffy, (floor temperature—80°, Air temperature—70°) and as a consequence the organization was more alert, and output efficiency was greater, than had been the case in the former factory where a different type of heating was used. Lost time due to colds was almost nil. The owners felt that humidity conditions were better (no ventilation was used but natural type). The accumulation of lint or factory dust on light fixtures was negligible. And the economy of operation was greater than anticipated.

SPECIAL QUALITIES

The use of wrought iron follows established engineering practice, and brings a number of advantages in installation and in use. Wrought iron is easily formed and welded. It has a high rate of heat emission. It expands and contracts at practically identical rates with concrete, minimizing the danger of thermal cracks and loss of bond. And its corrosion resistance has been convincingly demonstrated.

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If you are considering an installation, our bulletin "Byers Wrought Iron for Radiant Heating "will give you complete information on principles, calculation, layout methods, and results. Ask for a copy.

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POWER

PHILIP W SWAIN, EDITOR • SEPTEMBER 1948 • ESTABLISHED IN 1882

'HANDBOOK ENGINEER'

SOME FOLKS CLAIM that an engineer doesn't need to know much, if he "knows where to turn for information when he needs it." Dangerous half-truth!

Such a man is a "handbook engineer." He keeps his brains on a shelf—very good brains, but attached to the owner by a defective system of remote control. He can generally find you an answer in the book, but it's likely to be the wrong answer, or not the best, because it takes knowledge to use a book of knowledge wisely.

These comments are no reflection on handbooks, and naturally not on our own product, the engineering magazine. Pound for pound, the engineer has no tools more valuable than the systematically recorded ideas, experience and thinking of other men. We believe in engineering handbooks, in multiplication tables, in dictionaries and encyclopedias, in law and medical libraries, in cook books.

What we don't believe is that a good librarian with all these books automatically becomes a good engineer, accountant, lawyer, doctor or cook. *These professionals differ from the librarian in that they have a lot of specialized knowledge in the head, as well as in the book.*

To be worth his salt every professional man must have a lot of miscellaneous knowledge always on tap under his hat.

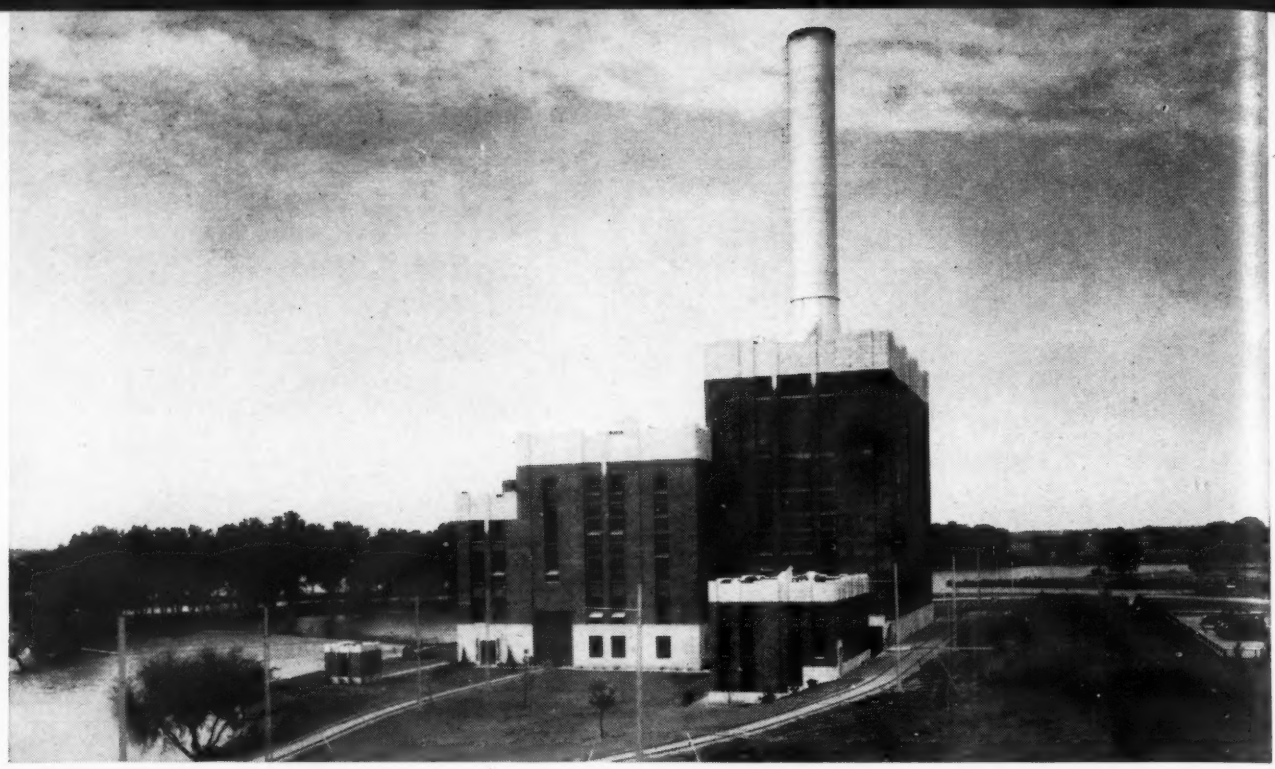
There are two reasons why this is so. One is the matter of time economy. If the doctor must turn to his shelf every time he prescribes for a cold, the author to his dictionary every time he writes a sentence, or the engineer to his handbook every time he wants to figure the weight of a tankful of water, he won't get much done. Every working professional must keep a lot of facts in the back of his head for everyday use.

But even if the well-stocked head were not quicker than the page-turning thumb, there would still be a mighty good reason why a good library, used for reference only, could never make a good engineer. The good engineer must have perspective. He must be able to tie one fact to others, to relate the parts to the whole, to compare one way of doing a job with another, to see the whole effect.

He can no more do this by looking up a few disjointed facts than a man without literary training can write a good book out of the dictionary. All the words are there, but he won't know how to hook them together.

The good engineer must build the framework of his engineering skill into his head by regular reading and long experience. Then he can safely use reference study to round out his equipment to meet some special problem.

You can generally lean on the judgment of the engineer who comes pretty close to the right answer without referring to any book, but who has also the humility to turn to the printed page for checking, amplification and special information, and has the skill to use this resource effectively—in short, the man who has the right handbooks and is not ashamed to use them freely, but is not a "handbook engineer."



1 Arthur S Huey Generating Station, Oklahoma Gas and Electric Co, has two turbines with total capability of 56,000 kw, but boilers limit output to 51,000 kw. New gas turbine will work in conjunction with the existing station heat balance

3500-Kw Gas Turbine Raises Station

First commercial power producing gas turbine in U. S. A. will operate with existing steam plant. New capacity is obtained at lowest cost and improves overall heat rate

► WHAT IS ALMOST CERTAIN to be the first gas turbine producing power commercially on a U. S. utility system has been purchased by Oklahoma Gas and Electric Co from General Electric Co (POWER, May 1948, p 94). A 3500-kw simple-cycle unit, it will be installed at OG&E's Arthur S Huey Generating Station near Oklahoma City, initial work probably starting about Jan 1, 1949. An abundance of low-cost high-Btu natural gas and favorable conditions for working the gas turbine into the existing plant heat balance make the installation attractive, extensive studies show.

Station History. Byllesby Engineering and Management Corp (now Pioneer Service and Engineering Co) designed the original installation at Huey Station. Operation started in 1930 with No. 1 unit, a 30,000-kw Allis-Chalmers steam turbine, supplied by three 150,000-lb-per-hr Springfield boilers. One of the three boilers was intended as a spare. Operating conditions were 400 psig, 750 F, 2 in. Hg abs backpressure. Gas-burning equipment with fuel-oil standby was installed and building and draft provisions made for future installation of coal-burning equipment. Subsequent operation showed that boiler output could be raised to 200,000 to 220,000 lb per hr with gas fuel but with proportionate drop in efficiency, increased maintenance because of internal circulation difficulties and shorter life of superheater tubes.

At the beginning of World War II it became apparent that additional system generating capacity was mandatory with a minimum expenditure of critical material and manpower. With WPB approval it was decided to add No. 2 unit, a 20,000-kw (25,000-kw capability) General Electric turbine-generator, to take advantage of the proven reserve boiler capacity. Present station capability now is only 51,000 kw, limited by maximum heat input to boilers, although the turbine units have a combined capability of 56,000 kw.

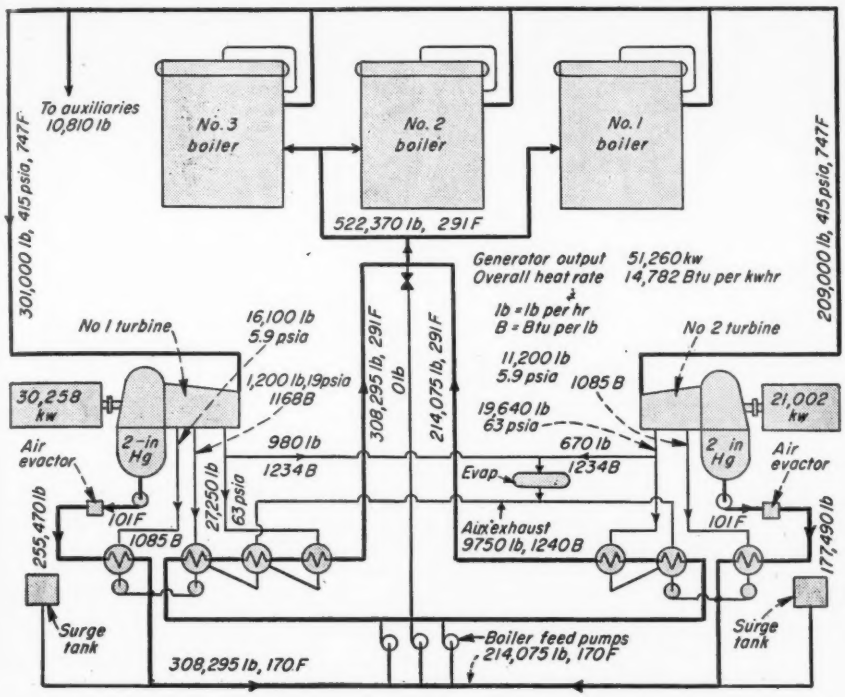
The Post-War Demand. The unprecedented and unexpected increase in power demand since World War II concentrated attention on, and study of, all possible sources of potential supply which could be obtained economically and quickly. Huey Station was immediately attractive because of its extra turbine capability. First consideration was a fourth boiler, but the high unit cost, two-year delivery or longer and gain of only 5000 kw made it not too attractive for the current situation, although it was definitely indicated for some future time.

Bleed-Steam Power. Supplying external heat for raising feedwater temperature thereby releasing bleed steam for power and increasing station capability was studied. Four means, original with OG&E, were investigated:

(1) Using steam from existing 165-psi boilers in an older nearby station. This steam would be used in the closed heaters so no mixing of boiler water from the two plants would occur.

(2) Similar to (1) except portable gas-fired oil-field boilers would be installed adjacent to the station, using the same boiler-water system.

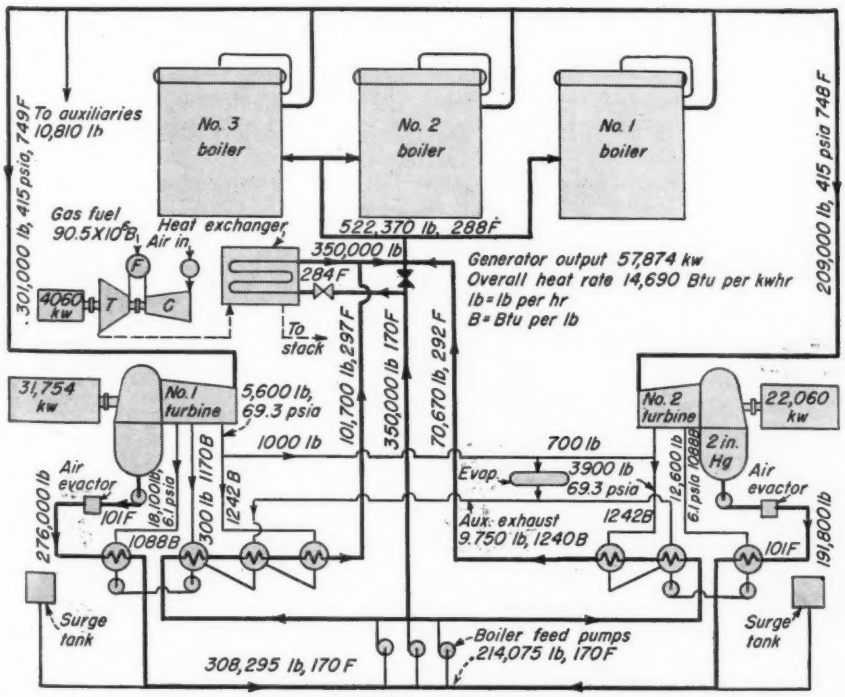
(3) Installation of a gas-fired feedwater heater, similar to those used for



2 Present heat balance of Huey Station includes three boilers and two turbines with regenerative feed heating. All boilers may feed either of the turbines

Capability By 6000-Kw

By J W BLAKE, *Oklahoma Gas and Electric Co.*
and R W TUMY, *General Electric Co.*



3 Exhaust of gas turbine will pass through heat exchanger heating feedwater that has bypassed the turbine closed heaters. This raises steam-turbine kw output

waste-heat recovery on diesel engines.

(4) Installation of a simple-cycle gas turbine, operating on natural gas, and equipped with an exhaust-gas-recovery heat exchanger.

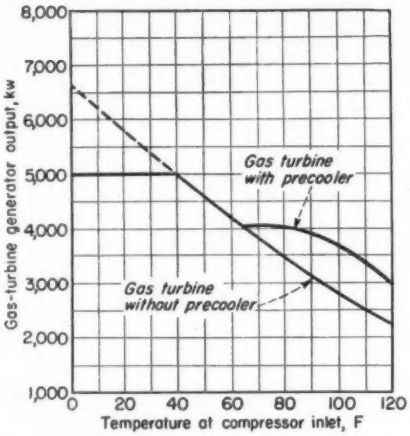
The first three methods would gain up to full capability, or 5000 kw additional from the steam turbines. However, this would be done at an increase in station heat rate. The fourth method, using a simple-cycle low-efficiency gas-turbine unit with heat exchanger, would produce a combined station capability increase in excess of 6000 kw, and if fully expanded by adding two more gas-turbine units would raise station capability a total of 15,500 kw. The additional capability is produced at a heat rate lower than the present base station heat rate.

Heat Balance. The station, located on a lake, has its circulating water cooled by natural evaporation and recirculation, augmented in summer months by a 13,600-gpm induced-draft cooling tower. Annual average back-pressure equals 2 in. Hg abs with outside temperature of 70 F. Fig. 2 shows present station heat balance before adding to gas turbine.

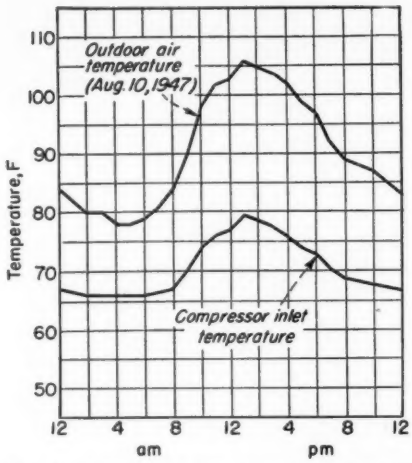
In investigating gas-turbine use it was necessary to be sure the unit would function as required during the peak season. For the OG&E Co the peak demand comes in the hot summer months. A gas turbine is least attractive with high ambient temperatures since the compressor is a volumetric device and delivered air weight varies inversely with the inlet temperature. The installation proved justified for air temperatures which prevail during the summer. A precooler will be installed at the compressor inlet, which will drop the inlet temperature about 25 F below ambient during the hottest weather.

More Kilowatts. Makeup for the lake, supplied in part, by deep wells at 65 F, will do the precooling. Originally this water was put into the lake via generator air coolers and oil coolers on the steam units. The quantity of water available will allow passing it through the gas-turbine precooler without impairing effectiveness of its original use. Fig. 4 shows estimated effect on gas-turbine capability of the precooler with high ambient temperatures. Actual ambients in this area reach values shown in Fig. 5. Also shown is the inlet-air temperature for the compressor.

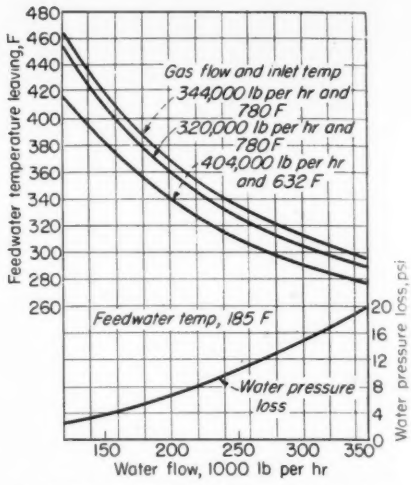
Gas-turbine exhaust temperature has been limited to a maximum of 780 F by the manufacturer. This will be the limiting factor in loading the unit except at low ambients when generator rating will be the limit. The high exhaust-gas



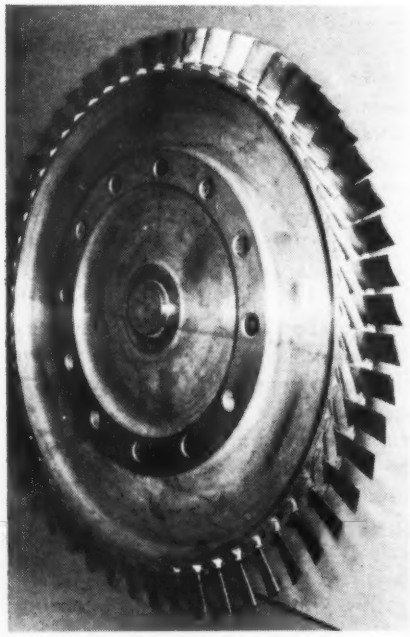
4 Precooler at compressor inlet raises unit output at high air temperatures



5 How precooler will lower compressor inlet temperature during summer day



6 Predicted performance of heat exchanger with given inlet temperature



10 The 15th-stage compressor wheel shows method of mounting blades

temperature makes it attractive for reclamation of heat for feedwater.

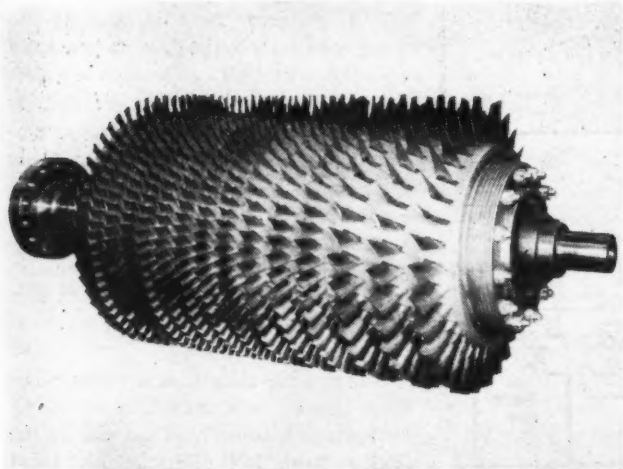
Exhaust-Heat Recovery. In applying an exhaust-gas heat exchanger to the unit, determination of amount of transfer surface was one of economics and indicated a unit of 18,950 sq ft. Performance of this heat exchanger with variable water and exhaust-gas flow is shown in Fig. 6.

In normal routing of feedwater the heat exchanger will function in parallel with the closed heaters. Automatic control will divide the flow to hold either constant feedwater temperature or final steam temperature. This control is desirable since the final steam temperature on the boilers is a function of feed temperature, see Fig. 7. For periods of reduced-load operation it may be necessary to operate steam units nonbleeding. For such operation the heat exchanger will be in series with the closed heaters. This will allow the gas turbine to operate at full load. If it is desired to reduce the gas-turbine load during load-reduction periods, however, then the routing can be left as described for normal.

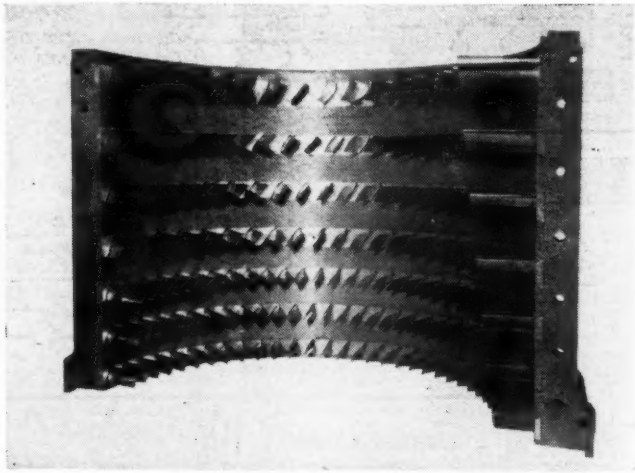
Performance. Fig. 8 shows the gain in kw output of the station by using the gas turbine, also the heat rate of the additional capability and the heat rate of the gas turbine with no exhaust-gas recovery.

Fig. 3 shows the station heat balance with the gas turbine operating and is directly comparable with Fig. 2 showing the original heat balance. Results of comparative performance studies at variable backpressures and loads are shown in Figs. 9, 16 and 17.

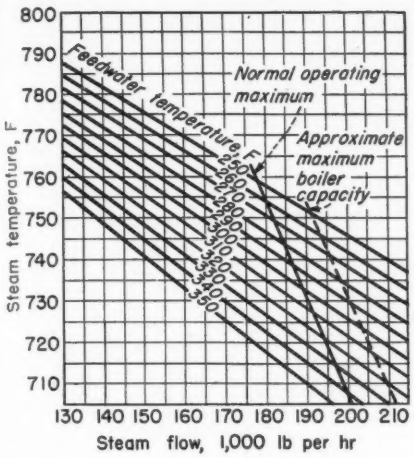
Installation. The entire project will be engineered and designed by the Pioneer Service & Engineering Co, Chicago, and will be installed by the Con-



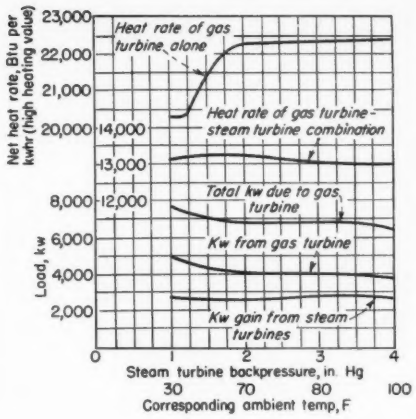
12 The 15-stage compressor rotor is made up of individual wheels bolted together, first six are of aluminum alloy



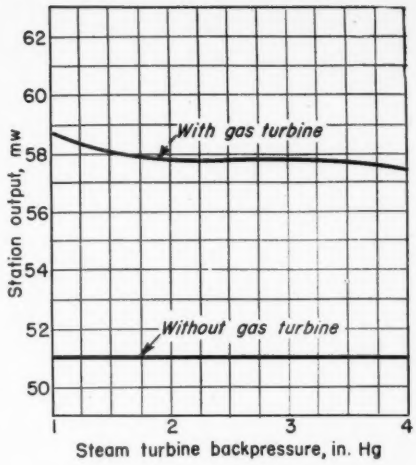
13 First half of compressor casing is also made of an aluminum alloy, remainder of rotor and casing is of steel



7 Boiler steam temperature depends on feedwater temperature and steam flow


Net heat rate, Btu per kwhr (high heating value)
Load, kw
Heat rate of gas turbine alone
Heat rate of gas turbine - steam turbine combination
Total kw due to gas turbine
Kw from gas turbine
Kw gain from steam turbines
Steam turbine backpressure, in. Hg
Corresponding ambient temp, F

8 For constant steam flow, combined performance varies with backpressure



9 With constant steam flow, combined capacity remains almost constant

struction Dept of the OG&E Co. The gas turbine will be housed in an inexpensive building added to one side of the existing plant, Fig. 18. With operating floor at same level as existing turbine-room basement, the auxiliary engineer will be responsible for the gas-turbine operation.

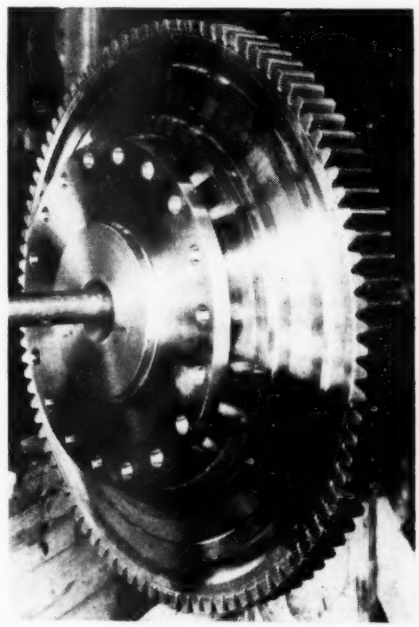
Natural gas will be supplied to the unit at a minimum pressure of 100 psi. The compressor air inlet equipped with a filter and precooler is expected to reduce intake air noise to a reasonable level.

Turbine exhaust will flow through the building wall in an insulated duct and then downward through the heat exchanger. The inlet piece will have a damper which can be positioned to allow free atmospheric exhaust if it becomes necessary to operate the gas turbine with no water flow through the heat exchanger. Exit gas will be conveyed from the heat exchanger to an unlined steel stack placed against the existing building wall, extending up to just above the coping.

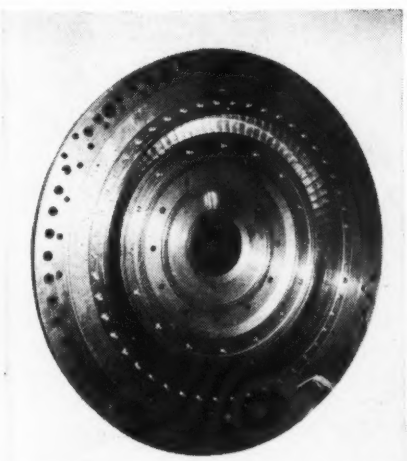
The gas-turbine building will have a standard crane with power hoist operated from the floor. Ample laydown space is provided for overhaul of the unit. A large door will allow trucking or dollying any part of the equipment into the main plant machine shop. The control board will be adjacent to the starting motor to make it more accessible for the auxiliary engineer.

The gas-turbine generator output will go to the plant bus at 13.8 kv and will be used for system capacity, just as does the steam-turbine output.

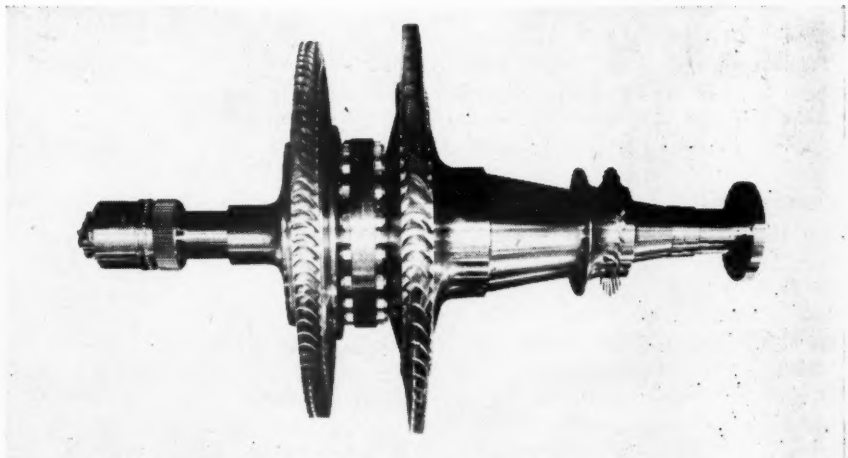
Gas Turbine Unit. Though the General Electric unit is designed for initial temperature of 1400 F, tests on an exact duplicate unit indicate that full load can be developed at a somewhat lower



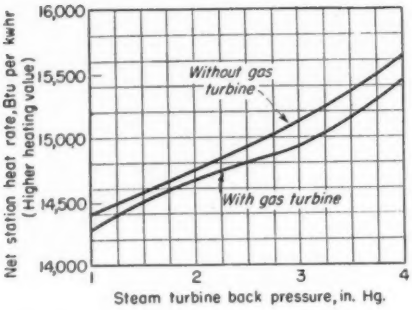
11 Each turbine wheel is built up of stainless rim and low-alloy center



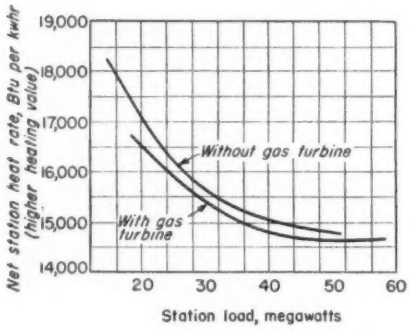
14 Discharge side of turbine first-stage nozzles, gas enters at 1400 F



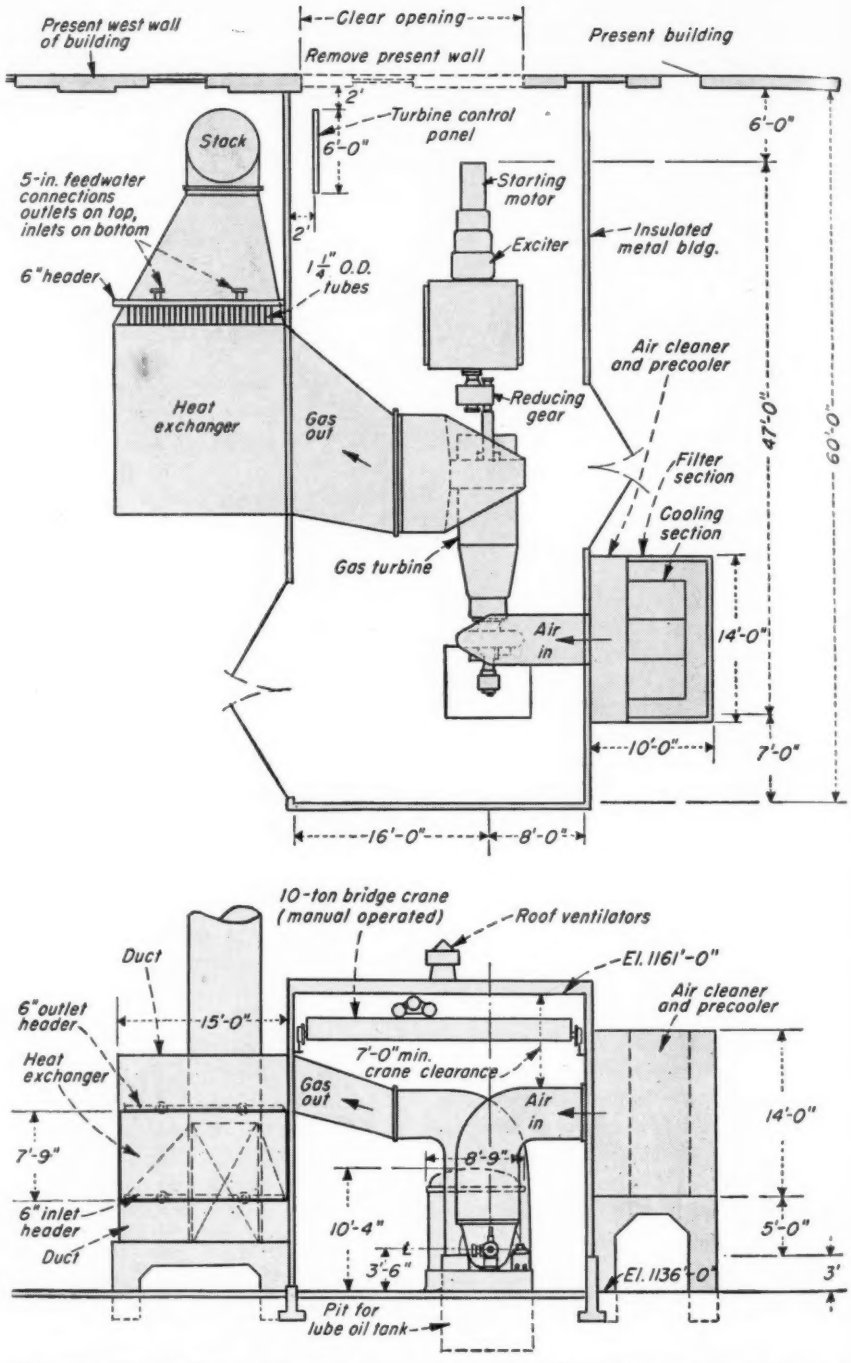
15 Turbine rotor consists of two wheels, each with its own shaft, bolted together. First of two impulse stages operates at 1160 F. A fan cools the exhaust casing



16 Gas turbine lowers plant heat rate at all turbine-condenser pressures



17 Gas turbine improves overall plant performance at all load magnitudes



18 The gas-turbine unit will be housed in a new building abutting present station building, with both heat exchanger and combination air filter and precooler situated outdoors. Unit will burn natural gas and have own exhaust stack

temperature. Use of a "minimum" open cycle hookup permits the unit to be simple in design, lightweight and inexpensive. Normal rating of the unit will be 3500 kw based on ambient temperature of 80 F and an altitude of 1500 ft.

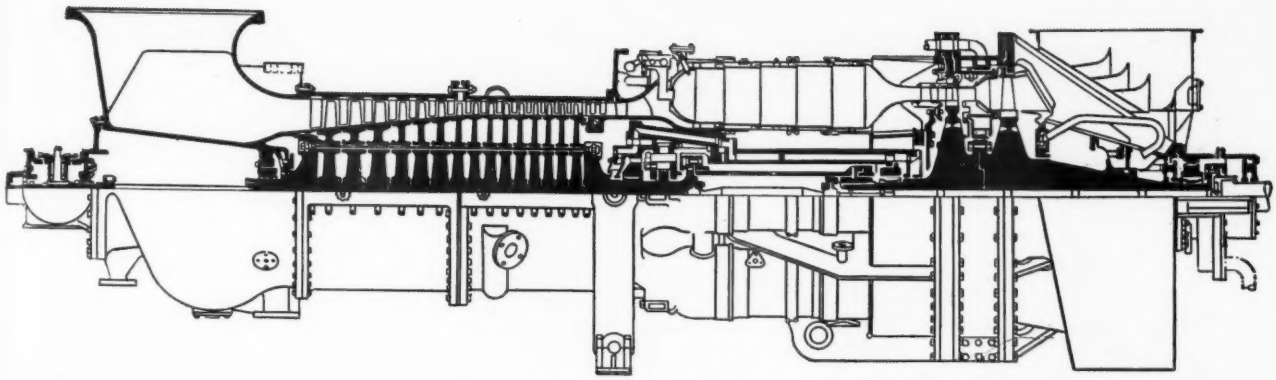
The turbine, direct connected to the compressor, runs at 6700 rpm. A precision helical gear couples the turbine to a conventional 4000-kw 3600-rpm generator and exciter, see Fig. 18. The OG&E Co requested the oversize generator.

Atmospheric air enters the compressor to be raised to about 87 psia at full load. The high-pressure air then enters six cylindrical combustors where burning fuel raises the temperature to that required for the load. With the essentially constant air flow, turbine inlet temperature will vary directly with load. Hot high-pressure gas then expands through the turbine.

Since the net power equals the difference of gas-turbine output and power required to drive the compressor, and power needed to drive the compressor remains constant, efficiency falls off as load reduces. The unit design, as far as gas turbine and compressor are concerned, is identical with the one which has been on test at the General Electric plant, Schenectady, New York, for some time, (see POWER, May 1948, pp 95, 98, and August, 1947, pp 68–70). Fig. 19 shows a cross section of the unit.

Compressor. The axial-flow compressor has 15 stages, for a compression ratio of about 6:1. The built-up rotor has separate wheels held concentric by fits near the center with through bolts holding the wheels together. This permits complete freedom of selection of materials for each stage. For example, in the low-temperature section, the first six stages, a light aluminum alloy is used for the wheels, reducing weight and rotating inertia, while on the high-temperature section steel wheels are used. Steel blades are used throughout. Fig. 12 shows the complete rotor. The vortex-type blading similar to that used on aircraft gas turbines is secured to the wheels by dovetails.

The stator has similar blading, but they are in dovetails in half rings which are inserted in grooves cut in the casing. The casing is made up of two halves,



19 Simple-cycle gas turbine unit develops 3500 kw at 1400-F turbine-inlet temperature. Left to right: compressor inlet, 15-stage compressor, 6 combustion chambers, 2-stage impulse gas turbine, exhaust hood. Unit runs at steady 6700 rpm

each split on the horizontal centerline. bolted together. This construction allows easy disassembly without sacrificing the casing's strength to resist distortion under transient conditions. As in the rotor, the low-temperature section of the casing is aluminum and the high-temperature end is of steel, Fig. 13.

Combustors. Six combustors are equally spaced around the body of the unit between turbine and compressor. Fig. 22 shows the elements of one combustor. Because of the high operating temperature it is reasonable to expect that the metallic inner liners will be the highest single maintenance item, hence this design permits easy and inexpensive replacement of the liners, if necessary. The inner liners, about 35 in. long and 10 in. dia, are of stainless material and outer casings of carbon steel.

To mix the combustion products adequately and avoid possibilities of local hot spots, the inner liner permits air to enter through annular slits between the various sections as well as through radial holes and louvers. The design gives excellent combustion over a wide range without sacrificing stability or ignition characteristics.

While the tests in Schenectady are being made on Bunker C and diesel oils, this installation will use natural gas fuel. It is felt that no fundamental problems will be involved with gas as compared to oil, but to be sure, tests are now being conducted using combustors fired with natural gas.

Combustion starts by means of spark plugs located in two of the six combustion chambers; cross fire tubes ignite the remaining combustors. Aircraft units have used this arrangement for some time and it proves reliable and effective. As in a gas-fired boiler, combustion is a continuous process after the initial start.

Turbine. The two-stage gas turbine achieves compactness and simplicity and keeps the first-stage bucket temperature as low as feasible. With an inlet temperature of 1400 F, the first-stage buckets operate at 1160 F, not much higher than the buckets in some high-temperature steam turbines.

The turbine rotor consists of two wheels, each integral with its own shaft. The two shafts bolted together form the complete rotor, Fig. 15. Each wheel is made up of two parts, the rim of high-temperature stainless material and the center portion of low-alloy high-strength steel suitable for 700 F, Fig. 11. Welding the stainless rim to the wheel allows using the proper material for each section of the rotor. This composite construction has proven wholly successful in airplane jet units. In addition, the forging and quality control problems are materially reduced.

The considerable step-up in height of buckets between the two stages keeps the leaving losses to a low value.

The first-stage nozzles, Fig. 14, of the welded type, are not split on the horizontal center line as is common in steam turbines. The partitions are welded to an outer ring and come through closely fitted holes in an inner ring. These two rings welded to two additional rings form the completed diaphragm. This construction permits free expansion radially and maintains concentricity without the use of pins or keys.

The second-stage nozzles use the same construction except that the partitions are welded to the inner ring also and the assembly is split on the horizontal centerline.

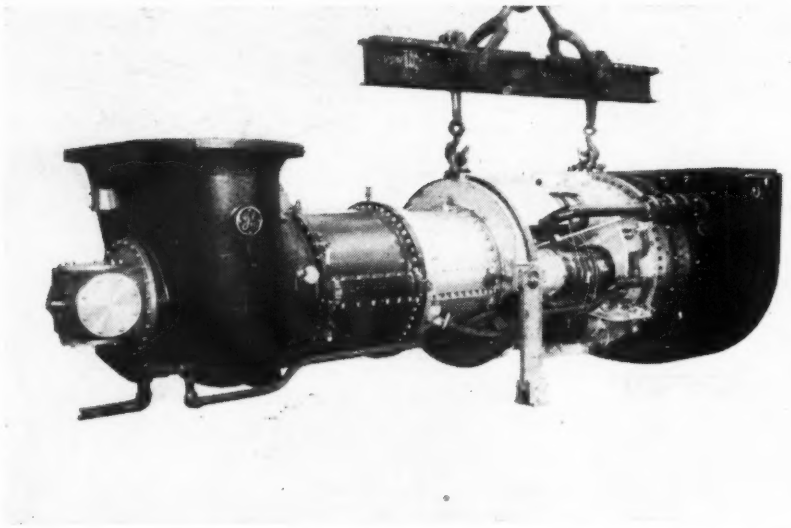
The casing is made up of circular rings opposite each wheel with L-shaped pieces bolted at the inside diameter to form the gas path and surface opposite which the blade tips run, Fig. 19. The rings are of ordinary carbon steel while the inner pieces are of stainless. These rings are bolted to the casing of low-carbon steel. The ring opposite the second stage is welded to six struts inside the exhaust hood and supports the low-pressure turbine bearing.

Air Cooling. Air from an intermediate stage of the compressor cools various parts of the turbine. It reaches the wheels by being bled into the space between the wheel and its adjoining diaphragm wall. Pipes also carry extracted air through the nozzle partitions across the gas path to the packing. A small fan on the turbine shaft sucks air through axial holes in the casing ring to cool the exhaust casing. Cooling air also passes through hollow tubes over the struts in the exhaust casing, thus keeping them from coming in contact with the hot exhaust gas and minimizing any distortion that might be caused by uneven temperatures. The exhaust hood is of ordinary steel with insulating lagging.

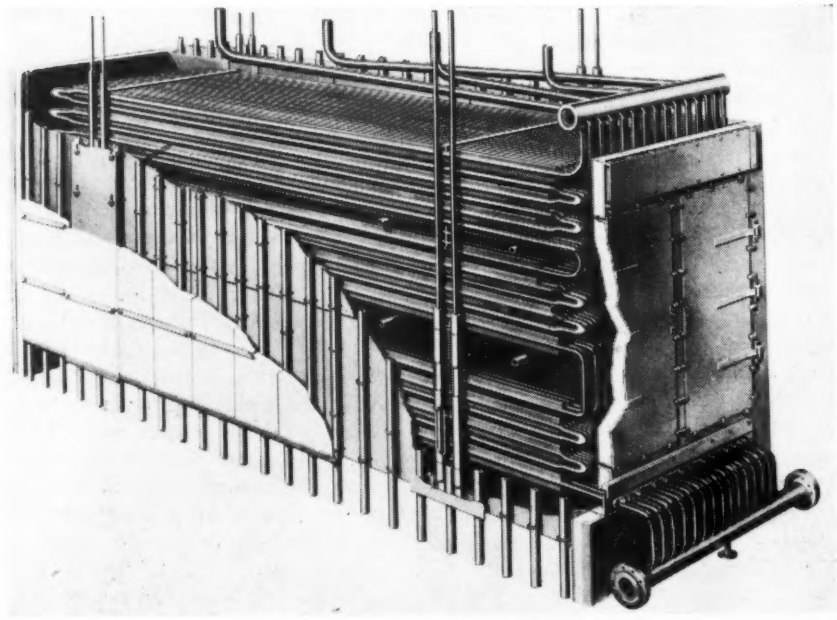
Auxiliaries. Normal turbine accessories are supplied with the unit and in addition many protective features are included. An accessory gear box mounted on the front end of the unit drives a tachometer, overspeed governor, lubricating-oil pump and fuel regulator.

The speed governor is electro-hydraulic, similar to those used for some steam turbines and diesel engines. A permanent-magnet electric-tachomter-generator gives the speed indication which is transmitted hydraulically to the fuel regulator. The latter varies the gas supply to the combustors in terms of load requirements. In addition to the speed regulating equipment the governor has an over-riding control to limit the exhaust temperature.

An auxiliary 400-cycle motor-generator set provides power for operating the motor control. A conventional over-



20 Partly assembled gas-turbine unit: precooler and filter will be arranged before the compressor inlet at left, exhaust at right will pass to heat exchanger



21 Heat exchanger has total effective surface of 18,950 sq ft, made up of continuous multiple-loop, finned tubes. Flows are down for gas, up for water

speed governor trips a control valve in the gas supply line. Alarms are provided for loss of flame, high exhaust temperature, excessive generator temperature, high bearing-oil temperature and low bearing-oil pressure.

Fig. 20 shows the complete compressor and gas turbine unit and the method of handling it. The weight of this rigid self-supporting structure is only 20,000 lb. The complete unit, Fig. 18, is less than 50 ft long and 9 ft wide, and located all on the same floor line with the exception of the oil tank. Consequently. installation problems are very simple since only a flat concrete slab is needed for support. The foundation loading is low, carrying a total of only 60,000 lb.

Exhaust Heat Exchanger. The exhaust-gas heat-recovery unit selected is a form of Combustion Engineering Co's Elesco marine economizer. This unit, similar to Fig. 21, is about 16 ft long, 14 ft wide and 8 ft high. Arrangement of the fin-tube heating surface minimizes draft and pressure loss because of the reduced length of tubing required for any given performance condition. The sinuous passages formed by the fins assure effective contact of the gas with all parts of the heating surface and also minimize formation of eddy currents. Unit will be provided with a weatherproof insulated housing suitable for outside installation. Fabrication of the waterside will be by welding. Specification and estimated performance for the unit are shown in Tables 1 and 2.

Automatic Feedwater Control. Proper division of feedwater between closed heaters and the heat exchanger to maintain constant steam temperature will be accomplished automatically by controls and valves designed and furnished by Bailey Meter Co. Because of the boiler superheater characteristics it is necessary to vary the feedwater temperature in order to hold a constant steam temperature with changes in output.

I: Specifications of Gas-Turbine Heat Exchanger

Type	Continuous multiple-loop, finned-tube
Number of tubes wide	76
Number of tubes high	20
Tube-bank arrangement	7-6-7
Horizontal spacing	2⅛ in.
Vertical spacing	2¾ in.
Size of elements	1¼ in. x 9 BWG
Fins	Split type
Lengths of elements	About 15 ft between casing plates
Gas flow	Down through heat exchanger
Water flow	Up through tubes
Heating surface	18,950 sq ft

II: Design Conditions and Expected Performance of Gas-Turbine Heat Exchanger

Ambient air temperature, F	120	80	0
Gas flow, lb per hr	320,000	344,000	404,000
Water flow, lb per hr	350,000	350,000	350,000
Gas temperature entering, F	780	780	632
Gas temperature leaving, F	317	324	453
Water temperature entering, F	185	185	185
Water temperature leaving, F	289	295	277
Water pressure loss, heater only, psi	20	20	20
Heat recovery, million Btu per hr	37	39	37.5
Draft loss (1500 ft elev), in. H_2O	0.9	1.0	1.3

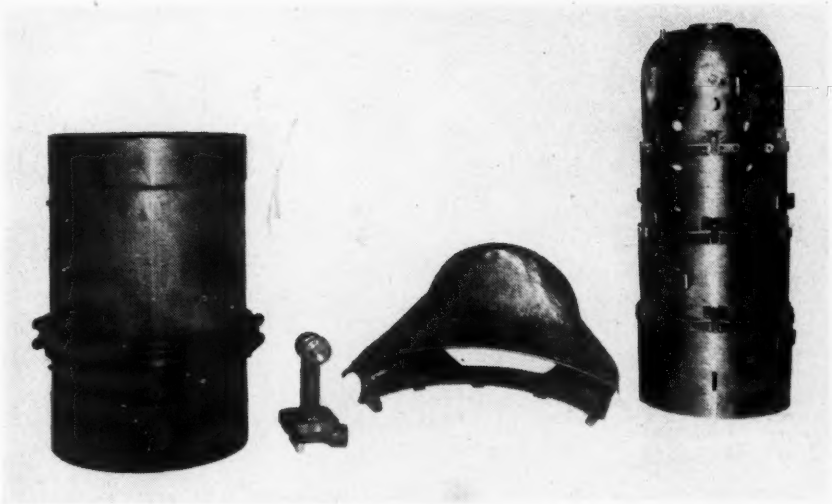
Air Filters and Precooler. The inlet to the gas turbine will be equipped with a sectional filter made by the American Air Filter Co. The elements will be of the dry, cleanable type. The filter box or plenum chamber will also serve as a silencer. Between the filters and the compressor inlet there will be placed a precooler similar to a standard generator air cooler. This cooler will be of finned-tube design installed with the inlet-outlet water box at the top. For winter it is planned to drain the tubes through the return heads and leave tubes dry to prevent freezing.

Summary. It is believed that an entirely new application has been worked out for the gas turbine, also that the use of a precooler on a simple cycle gas turbine is without precedent. From the foregoing it can be seen that the addition of a simple-cycle gas turbine to this steam station will: (1) provide quick additional capability for the station by virtue of output from the gas turbine and increased output from existing steam turbines (2) make available this capability from regular station fuel rather than expensive diesel oil (3) defer investment for additional steam-generating equipment.

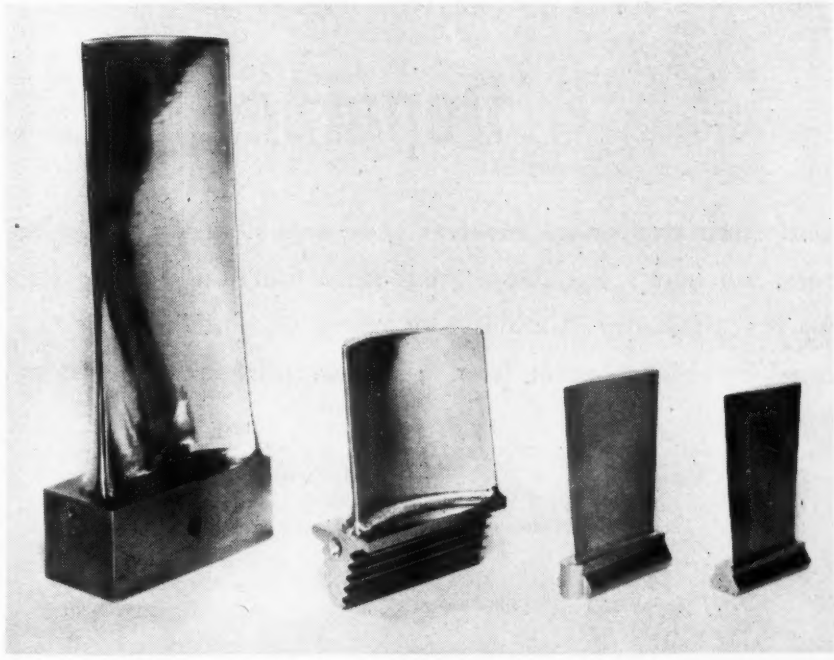
The cost of installation, based on peak-season capability increase will be somewhat less than a like amount of steam-plant capability. It should be kept in mind that the favorable application of the gas turbine to this station was due to certain peculiarities which existed therein, and unless similar conditions exist in other proposed projects, parallel results might not be obtained in terms of capacity and economy.

A study was made of combining steam and gas turbines, as applied in the manner here described, to a new station installation, using steam turbines straight-condensing only and supplying all feedwater heating from the gas-turbine exhaust. Table III shows the results for stations using gas fuel with steam conditions of 400 psig, 750 F, 2 in. Hg abs backpressure and having a maximum output of 25,000 kw. In the combination station the gas-turbine heat exchanger would have to be equipped for gas firing to provide feedwater heating in the event the gas turbine was out of service for any length of time.

In conclusion, the authors wish to acknowledge the part played by Mr Otis Howard, Manager of Operation, Oklahoma Gas & Electric Co, in promoting this project. His vision and faith in the future of the gas turbine have made this first commercial power-producing gas turbine in America possible.



22 Combustion chambers are made up of simple elements: left to right, outer casing, fuel-oil nozzle, transition piece and air-cooled inner liner of alloy

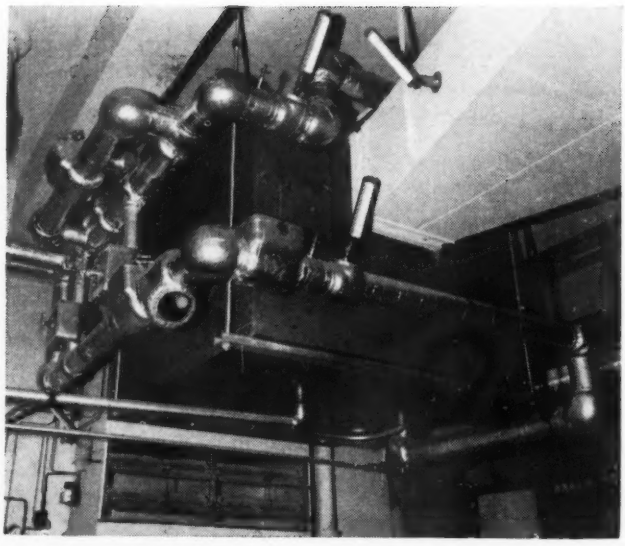


23 Appearance of blading in gas-turbine unit differs from that of most steam turbines, l to r, turbine buckets, 2nd and 1st stages, compressor blading

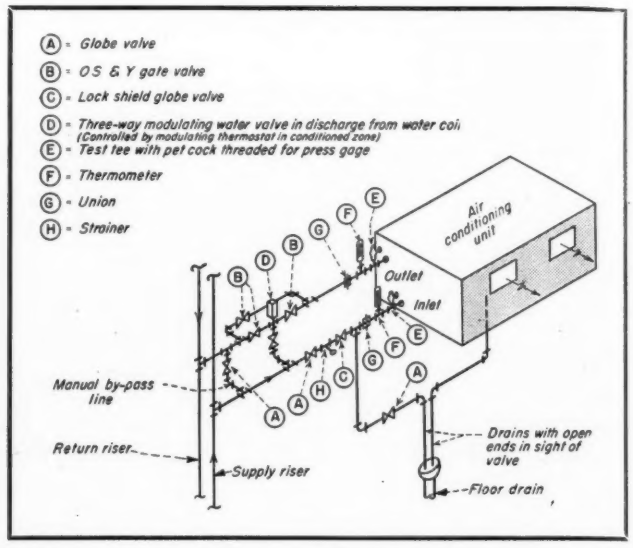
III: Comparison of Regenerative-Cycle Steam Station With Combined Straight-Condensing Steam Turbine and Simple-Cycle Gas Turbine, Exhaust Heating Feedwater

Station Factor	Normal Regenerative-Cycle Steam Station	Combination Straight-Condensing Steam Turbine, Simple-Cycle Gas Turbine*
Boiler capacity	100%	68%
Steam turbine capacity	100%	80%
Gas turbine capacity	0%	20%
Condensing equipment	100%	90%
Feed Heaters	100%	Deaerator and recuperator
Installation cost	100%	99% or less
Heat rate		Lower than for regenerative-cycle steam station

* Exhaust from gas turbine heats feedwater to boiler, steam turbine is not bled.



1 Fifteen factory-built air conditioning units, above, were selected to fit available area and height in stock areas

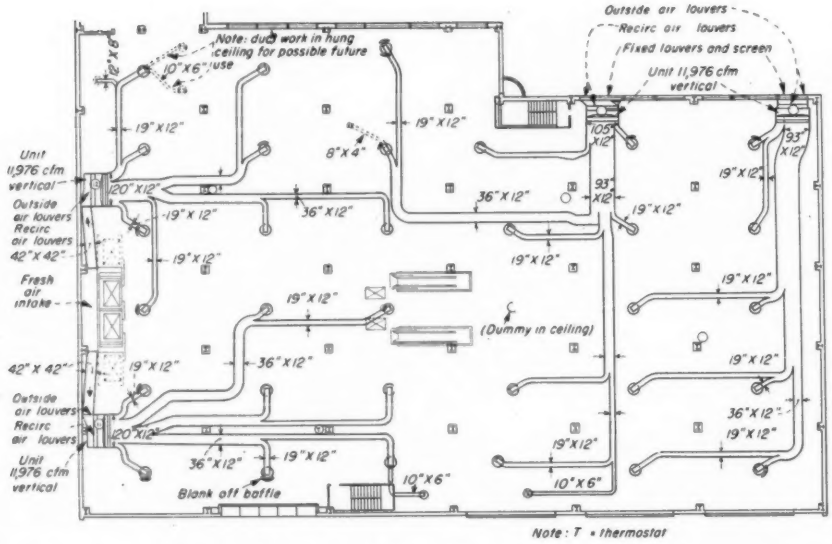

A = Globe valve
B = OS & Y gate valve
C = Lock shield globe valve
D = Three-way modulating water valve in discharge from water coil (Controlled by modulating thermostat in conditioned zone)
E = Test tee with pet cock threaded for press gage
F = Thermometer
G = Union
H = Strainer
Air conditioning unit
Outlet
Inlet
Manual by-pass line
Return riser
Supply riser
Drains with open ends in sight of valve
Floor drain

2 Coil connections to air conditioning units, above, supply chilled water to cool air distributed through the store

Department Stores Require

Usual store experience involves rearrangement of the sales floors. But here's one department store that manages to obtain the necessary flexibility by using unit air conditioners cooled by chilled water from a central refrigerating system

By T W REYNOLDS, Chief,
Air Conditioning Div, Abbott, Merkt & Co



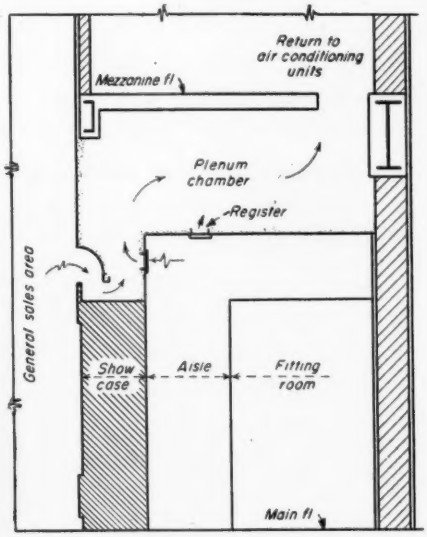
3 Typical floor plan for ductwork has main runs parallel to and between deepest beams with the short, shallow branches to the air outlets crossing these beams

▶ PHYSICAL LAYOUT of a department store is never constant. It starts to change even before it is finished, if it ever is finished. Take Burdines, Inc, of Fort Lauderdale, Florida. Right now, although it is a 3-story building of recent erection, provision has already been made for an additional three floors.

In this store there seemed to be more than the usual limitations in headroom and available floor area for ducts and equipment. These restrictions led to the use of small air-distribution centers and factory-built air-conditioning units at 15 points throughout the building, Fig. 1 and 2, with cooling obtained by chilled water from a central refrigerating system on the roof, Fig. 7.

Conditioned air from the air-conditioning units is distributed by means of short runs of small ducts, each connected to a limited number of ceiling supply outlets. Main runs of ducts parallel the deepest beams and shallow branches supply outlets crossing them, Fig. 3. Capacity of the air-conditioning units was set by (1) area and height available for them in stock areas (2) quantity of air the main duct from each unit could supply in the limited space of hung ceilings without air-velocity producing noise. Available space proved so tight that the engineers of necessity combined all mechanical services on one coordinated plan. From this, at his shop in the metropolitan area of New York, the sheet-metal con-

4 Fitting rooms, like those at the left, illustrate the problem of supplying air conditioning to partitioned spaces that are always subject to rearrangement



5 No return ducts as such are used. Plenum chamber serves mezzanine

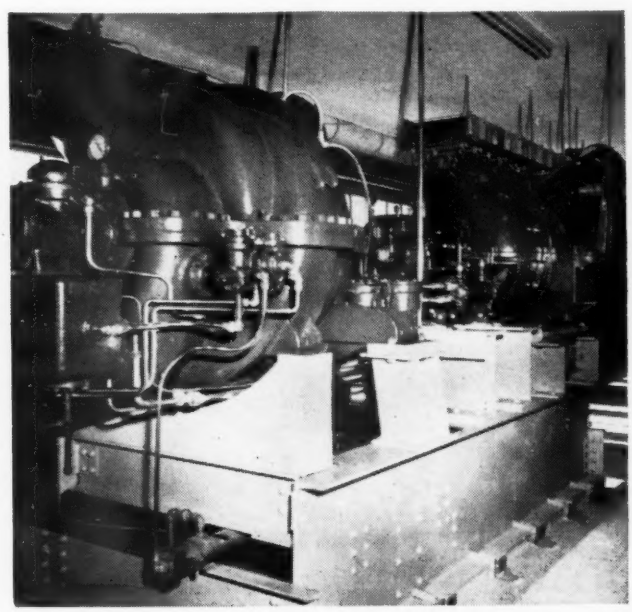
Flexible Air Conditioning

tractor worked in assembling the ducts in sections. Notwithstanding all this, they fit when put in place.

Fixing the Load. The item of diversity factor, usually set at 80%. did not figure in calculating compressor load. The effect that lights and people play on diversity factor in an installation such as this—only three floors and equipped with escalators—does not amount to much. Because of this, the total connected load and operating load were held to be one and the same.

But compressor selection involved another step—a rough estimate of expected load when the additional three floors are added. This resulted in picking a 540-ton compressor, Fig. 7. Its selection came about for these reasons: (1) Excess tonnage above the presently required 455-ton capacity cost only about 60% per ton of the quoted price per ton for a 455-ton unit. (2) Estimated total tonnage of 675 tons when the store is enlarged could be met with a 540-ton compressor operating on the usual 80% diversity factor. Incident-

6 Outlets spotted in ceiling and arranged in rows are large enough for both the present and future conditions



7 Chilled water for cooling air in unit air conditioners comes from central refrigerating compressor on roof top

Breakdown in Percent of Contract Cost

Refrigeration compressor and foundation	20.4
Cooling tower	5.3
Chilled-water pumps and controls	0.9
Condenser-water pumps and controls	1.1
Air-conditioning units, starters, controls	8.3
Temperature control	2.8
Sheet-metal work, freight included	26.2
Ceiling air outlets, registers, grilles	2.9
Exhaust fans, controls and bases	0.5
Insulation of pipes and ducts	9.5
Roughing materials, pipe, fittings, valves, welding and tools, rigging and equipment, freight and cartage, labor and insurance, expenses and miscellaneous job costs	16.1
Fee	6.0
Total	100.0

Total cost per ton = $557.00

ally, no spare has been provided, since many single installations have compiled records of no "in season" failures over a number of years service.

Heating Load. No heating plant was furnished. Internal heat load in this section of Florida reaches the point where turning on lights shortly before the store opens provides enough heating. As customers increase in numbers they supply any additional heat needed. In fact, it is more common to cool lower floors at all times, particularly at the Christmas season or on bargain days.

Design for lower Florida installations must meet conditions peculiar to that area. Burdines' system, while designed for the usual maximum load at 78-F dry bulb and 50% relative humidity, can operate at higher dry-bulb temperatures, as may be required in this semi-tropical climate. In fact, comfort zone in the deep South differs from the Northern interpretation.

There are interesting design differences peculiar to this section, such as the need for structural steel to properly anchor duct work on the roof against hurricanes. Then, too, one can use a water-supplied wet-bulb control at the sectional, cooling units, simply because there is no danger of freezing. In this climate the control can be safely installed directly in the outdoor-air duct.

Facing the Future. Since Burdines' may become three stories higher provision had to be made for the future dismantling of the roof-top cooling tower and relocation of the central refrigeration compressor, together with their pumps. With this end in mind a make of cooling tower that lends itself to disassembling was selected. The cooling units at the floor levels are located on walls and will remain unaffected by any store changes, whether such changes are horizontal or vertical.

Over and above the planned store enlargement is the ever-present problem of providing for floor rearrangements and partition changes, Fig. 4, 5. Usually putting one outlet per bay centralizes distribution and lessens troubles from partition changes. If the outlet (1) gives good aspiration or mixing with room air within the device itself (2) has equalizing dampers so exit velocity is regulated across the outlet (3) has volume-control dampers, air can be carried within the ducts at lower temperatures than exist in the conditioned space. This practice of colder air within the ducts permits operating and equipment economies growing out of the use of smaller elements throughout.

Outlets spotted in the ceiling and arranged in rows improve appearance, Fig. 6. All outlets in view in a given area are the same size provided the selected size gives neck velocities within the minimum and maximum allowable. At the first-floor level, ceiling height is 19 ft 6 in., yet the outlets along with the lights are easily serviceable from a movable telescoping scaffold that is wheeled in from outside whenever required.

Spotting Outlets. Biggest problem in fixing outlet location is predicting future floor changes. Outlets arranged in rows of one outlet per bay should be large enough to serve present area plus some possible future added area. How does this added area come about? As one example, floor partitions separating specialty departments are often set up, Fig. 4, then changed on short notice. Outlets serving such areas should not be too close to a present partition, nor yet too far from the outside wall should the partition be removed. Of course, the outlet side nearest the partition should be baffled, but if the partition is taken down, removing the baffle reestablishes even distribution and yet covers the new area.

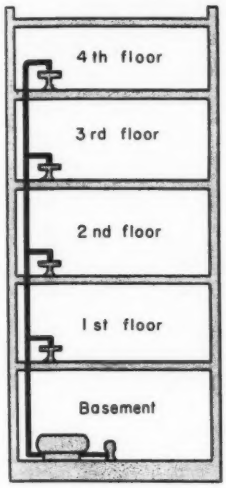
Present comfort needs would seem to dictate other locations for some of the outlets. On the other hand, the nature of department store business, requiring frequent rearrangements such as above, plus the heavy labor and material costs for changes in ceiling arrangement, makes a permanent, centrally located outlet system most economical and most feasible, even though the last word in present comfort is not obtained.

Selecting a System. The very same reasoning lies behind the choice of a modified unit system for air conditioning over a purely central distributing one. For example, some partitioned-off spaces within a store have few customers, and, in addition, a display arrangement that results in very little heat gain. To supply such an area from a central system requires a special zone treatment. Initially a zone like this can be readily set up and give adequate service. But as store changes occur the original zone controls no longer apply. The unit system proves most flexible in such a case.

Moreover, the overhead-beam construction lent itself to short runs of ducts, easily possible with a unit system. And the cooling units themselves, Fig. 1, are fairly small, occupy little area and have their weight rather evenly distributed. In cases of drastic department changes they can be moved fairly readily and without too serious interruptions and delays.

Highly interesting to both user and designer is the final report on costs, reproduced percentagewise above.

1 Usual high-level point

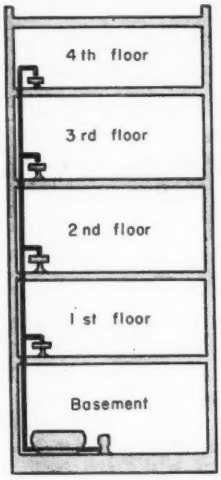


Tank pressure to give 15 psi at floor level	Amounts withdrawn to reach pressure level	Balance in tank
37 psi	150 gal.	510 gal.
32 psi	200 gal.	460 gal.
27 psi	270 gal.	390 gal.
22 psi	360 gal.	300 gal.

Tank empties at 11 psi

BANKING ON WATER LEVEL within a tank as an indication of the available water supply indicates a basic misunderstanding

2 Level affects capacity



Tank pressure to give 15 psi at floor level	Amounts withdrawn to reach pressure level	Balance in tank
37 psi	260 gal.	140 gal.
32 psi	355 gal.	45 gal.
27 psi	Tank empties by 30 psi	
22 psi		

MERELY CHANGING the initial high level setting of Fig. 1 delivers about twice as much water at all floors as before

Controls Make Hydro-Pneumatic Tanks

These tanks suffer from misconception of their function. They boost available pressure or stabilize varying supply pressure. Here's how controls make your tanks work better

By W L WEST, *President*
Automatic Control Co

▶ ALTHOUGH COUNTLESS NUMBERS of hydro-pneumatic, or pressure, tanks are used as a means of water supply, practically no consideration is given to their proper and efficient operation. They are usually chosen to fit a space, leaving entirely to chance the question of air-water ratio, of pressure settings, and even tank size. Much of the difficulty arises from a misconception of their function.

A hydro-pneumatic installation should be engineered to meet pump efficiency needs, and not be looked on as a means of storage. Its purpose is to (1) boost to a higher pressure water from a well or lower-pressure mains, or (2) stabilize a varying pressure supply between new limits. It is a tank of limited size, to maintain pressure within certain limits, and thus its primary purpose is not and cannot be storage.

Unrealistic High Levels. There are few ideas more unrealistic both in fact and theory than the old ⅔ rule of establishing high water level. Allowing only 1/3 of the tank for air space causes unnecessarily frequent starting of pump and undesirably fast pressure drops. Take, for example, the usual 1000-gal tank filled ⅔ full of water at 60 psi with pump set to start at 40 psi. Although containing 660 gal only 125 gal can be drawn off before pump starts. The operator believes at this low point he has 535 gal in reserve. Chances are, however, he can draw off only a small portion of these gallons before pressure drops way down—to where an outlet or nozzle loses its effectiveness, upper floors can no longer be reached.

He has 500 gal in storage, but at inadequate pressure. More water in the tank does not mean more water will be available *at the necessary pressure.* What is desired is water between definite pressure limits. If pressure falls below a desired operating level all water left in the tank becomes, for all intents and purposes, unavailable.

Look at Fig. 1. Here is a 4-story building with a hydro-pneumatic tank in the basement to boost well-water supply to a pressure sufficient for service use, about 15 psi at the faucets. This means 37 psi at the tank.

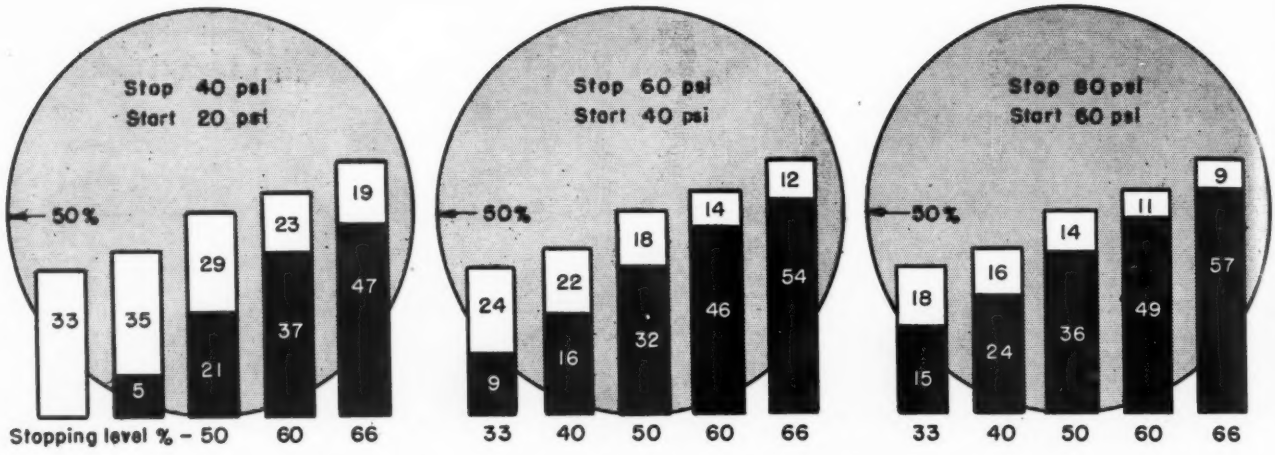
Following the usual rule of thumb, the 1000-gal tank is set as above mentioned—filled with 660 gal (⅔) and pump set to start at 40 psi, off at 60. The 535 gal that remain when pressure drops to 40 is erroneously called a reserve. Suppose the pump fails, or demand becomes heavy, how much of this 535 gal actually is a reserve?

Withdraw just 25 more gallons (150 total) and pressure in the lines, Fig. 1, becomes barely equal to fourth floor needs. Take out another 50 and only the first three floors have service. If 300 gal total are withdrawn, 360 gal remain in the tank, but at what pressure? Only 25 psi—just enough pressure to feed the first floor. You could scarcely call such a service reserve capacity.

Pump Operation. Now let's see what happens if the pump works when tank pressure falls to 40 psi. In Fig. 1 a 100-gpm pump serves the installation. The system demand reaches a consumption rate of 50 gpm for considerable periods. First reaction is that a 1000-gal tank supplemented with a 100-gpm pump can easily handle a 50-gpm consumption.

But at 50 gpm a withdrawal of 125 gal takes only 2½ minutes. Pressure drops to 40 psi. The pump starts and delivers 100 gpm. Half of this delivery goes to meet demand so tank contents increase at only 50 gpm. As a result the complete pump cycle is 2½ min on, 2½ off. This means the pump starts

3 Tank Operation Under 20-psi Pressure Differential



Column height indicates high or stopping level at % of tank capacity, 33, 40, etc.
Upper number in column gives % water withdrawn between pressure limits
Lower number in column represents % water left in tank at starting pressure

twelve times an hour, pulling a heavy inrush of current five to ten times normal running current of the pump motor.

Can such a situation be corrected? Let's see how. Consider what happens with this same tank filled to within an inch of the top. Withdraw a few inches of water and pressure falls off almost to zero.

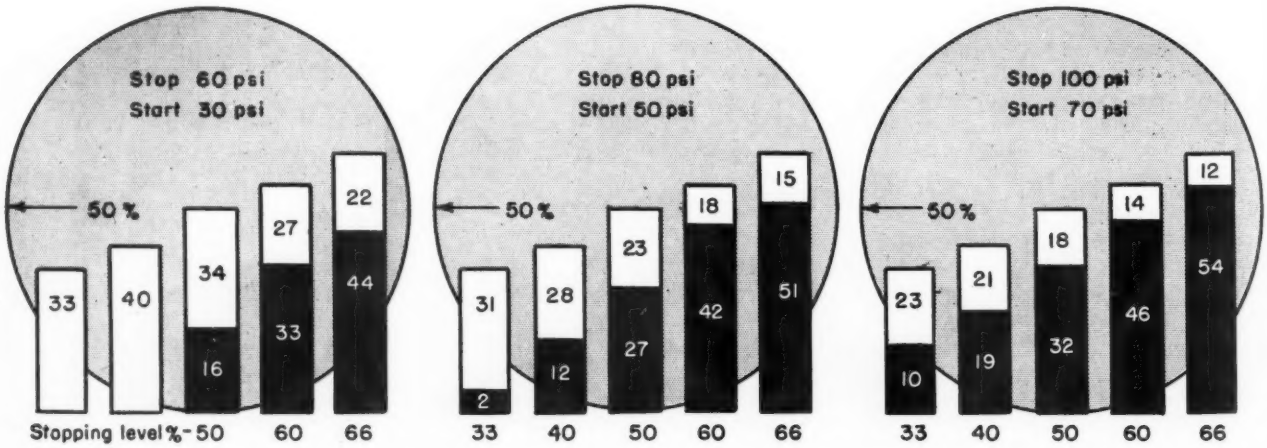
Changing Water Level. But, by contrast, start off with just a few inches of water and remainder of tank filled with air. All water in the tank can be pulled out with only a negligible pressure drop. In other words, the less water in a tank at high pressure, the more water can be withdrawn per pound of pressure drop. To avoid a fast pressure drop, as in Fig. 1, the high level should be set much lower than ⅔ the volume of the tank.

Fig. 2 indicates the action possible from a tank with its high level set at 40% of tank capacity and using pressure settings of 60 and 40 psi. By merely changing high-level setting, 220 gal can be withdrawn from a 1000-gal tank before the pump starts, as contrasted to 125 gal with a ⅔-high level setting.

Under the 40% setting 180 gal remain as a residual. Of this amount 40 gal can be withdrawn before pressure drops to border line for fourth floor use. This compares with 25 gal of the first example. Similarly, 300 gal total withdrawn from the 40% level brings tank pressure down to 35 psi as against a 25-psi condition for the original ⅔ setting. In fact, all 400 gal can be pulled out before pressure falls to 30 psi. Note that almost twice as much water becomes available *at the pressure desired* by lowering the high-level setting.

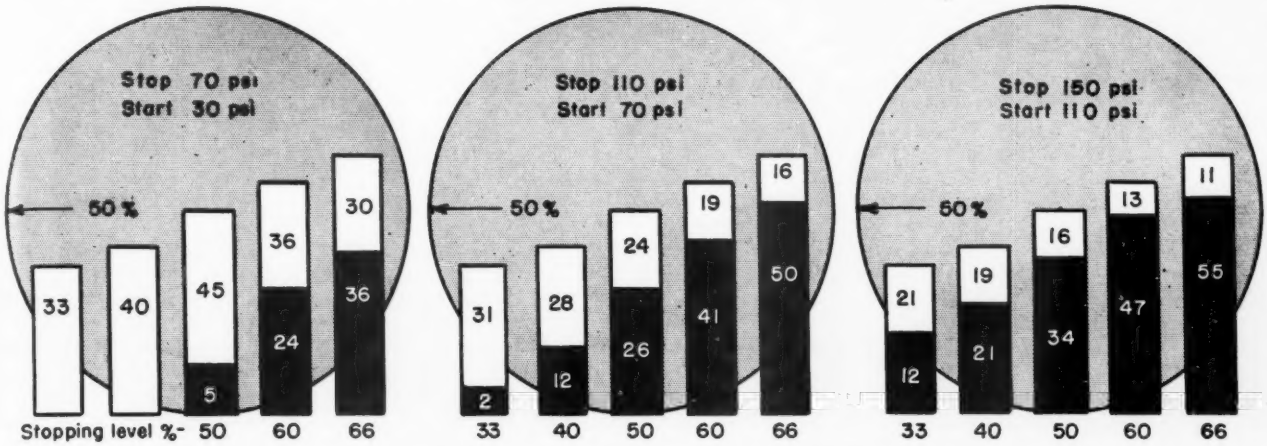
Pump operation also benefits. In the first case, the on-off pump cycle called for twelve starts an hour. With a 40%-

4 Tank Operation Under 30-psi Pressure Differential



Column height indicates high or stopping level at % of tank capacity, 33, 40, etc.
Upper number in column gives % water withdrawn between pressure limits
Lower number in column represents % water left in tank at starting pressure

5 Tank Operation Under 40-psi Pressure Differential



Column height indicates high or stopping level at % of tank capacity, 33, 40, etc.
Upper number in column gives % water withdrawn between pressure limits
Lower number in column represents % water left in tank at starting pressure

high level setting the cycle becomes seven times an hour with the pump on 4.4 min and off 4.4. With this setting a consumption rate of either 25 or 75 gpm results in only five cycles an hour.

Applying Basic Physics. The explanation for this condition rests upon simple physics—Boyle's Law. This law states that temperature being constant, volume of a given weight of gas varies inversely as absolute pressure. Expressed simply

$$\frac{P_1}{P_2} = \frac{V_2}{V_1}$$

Apply this to a hydro-pneumatic tank and it becomes apparent that with a small original air space a small water withdrawal causes a relatively large air-volume increase. For instance, with only one inch of air, withdrawing one inch of water doubles air space. V_1 undergoes a large change to become V_2 and pressure has to change considerably.

But if air occupies a large space originally, a few gallons of water withdrawn causes only a relatively small increase in air space and a fairly small pressure change.

In Fig. 1 a 1000-gal tank had 660 gal of water, and remaining 340 gal of space held air. Let V_1 represent original air volume expressed as gal space or 340, and V_2 air volume after 300 gal of water have been withdrawn, or 640. Then $\frac{V_2}{V_1}$ is $\frac{640}{340}$ or about a 47% drop in volume. Pressure goes from 60 psi down to about 25 gage.

With Fig. 2, V_1 was 600 and V_2 900. Then $\frac{V_2}{V_1} = \frac{900}{600}$ (about a 33% drop in volume) and pressure goes from 60 psi to 35 gage. Percentage of pressure drop in 1 is much higher than in 2 even though the same quantity in gallons (300) was withdrawn.

Full use of Boyle's Law for working out hydro-peneumatic tank problems involves reworking the equation repeatedly. But by using gallons as a measure of air space and deriving a special formula, calculations become simple. See p 160 for steps involved.

The formula $W = \frac{\text{high pressure}}{\text{low pressure}} \times \text{unused capacity} - \text{unused capacity}$.

Here W represents withdrawal in gallons and unused capacity is expressed in gallons as well. Pressures are absolute, that is gage plus atmosphere which can usually be considered as 15 psi. A simple rule for elevations well above sea level is to allow ½-lb drop in atmospheric pressure for each 1000 ft above sea level.

Practical Application. Now let's try an example—a 1000-gal tank filled to 40% of capacity and operating between 60 and 40 psi gage.

$$W = \frac{60 + 15}{40 + 15} \times 600 - 600 = 218 \text{ gallons}$$

that can be withdrawn. By this formula, amount that can be withdrawn at any intermediate points in the pressure cycle can be calculated.

You will note that no mention is made of tank shape or mounting—horizontal or vertical, cylindrical, spherical or square. As long as rated capacity is known these have no bearing on the application of the formula.

Tank shape has significance only when determining actual measurement of high-level setting and the number of inches of water seal to cover the outlet. Let's confine ourselves to cylindrical tanks. They may be vertical or horizontal. A vertical one presents no problem. The degree to which a vertical cylindrical tank is filled bears a direct relation to height.

A horizontal cylindrical tank requires conversion between height of fill and capacity. If diameter and rated capacity of tank is known there are tables available that can be put to use.

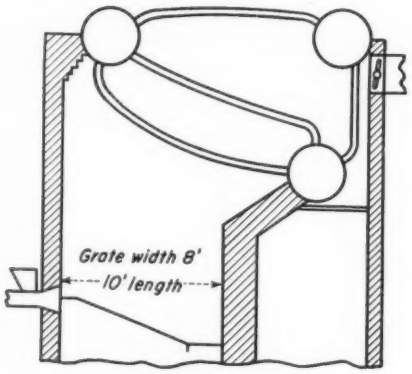
Now let's look for one more highly practical point, too often neglected. Sufficient water must remain in a tank at all times to cover its outlet-connection. If the outlet is above tank bottom it means a certain stagnant layer of water in which all silt collects.

By having the inlet for a horizontal tank at one end and slightly above the bottom, and the outlet at the opposite end out of the bottom a fresh-water supply always comes from the tank. This permits the tank to be self-cleaning, at the same time minimizing the water seal requirements. There is no fear of a loss of water seal since water has to drop below the first bend in the pipe before air can get in.

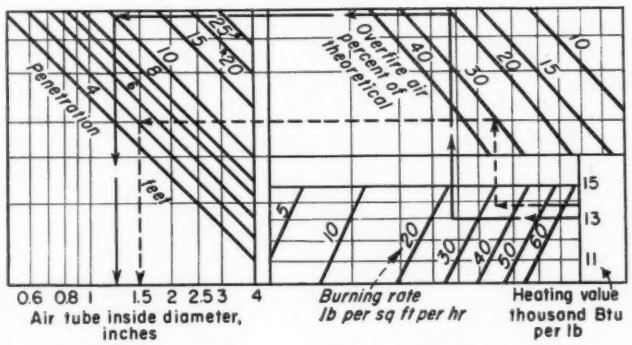
Control Pressure and Level. From the above, the operating advantages from just changing tank-water level are apparent. But even better performance comes from control of both pressure and level. Tanks receiving water from deepwell pumps get an additional charge of air each time the pump starts. In time, under pressure controls alone, water level would slowly drop until "air binding" resulted. On the other

(*Continued on page* 160)

BLOWER JETS: Simplified, Step-by-Step Procedure for Selection



1 Sample stoker-fired boiler, above, will have jets mounted in front wall


Penetration
Overfire air percent of theoretical
feet
0.6 0.8 1 1.5 2 2.5 3 4
Air tube inside diameter, inches
Burning rate lb per sq ft per hr
Heating value thousand Btu per lb

2 Applying the first four factors in Table II to this chart gives air-tube dia required for a blower-supplied jet

How Overfire Jets Can

Here's an easy-to-follow procedure that gets results in cutting down smoke from old boilers. All the details you need to build a set of workable steam or air jets—diameter spacing, number, capacity of the tubes—are discussed and explained

By L N ROWLEY, *Managing Editor*, and J C McCABE, *Associate Editor*

►A RELATIVELY INEXPENSIVE, quickly available tool for cutting down smoke in an old boiler sounds like magic. Yet Bituminous Coal Research, Inc has been running a series of jet clinics across the country to show combustion engineers where just such a tool has been put to work. This tool is an overfire jet.

Let's first look at the function performed by this jet, and then learn how to make and apply one. Smoke, as distinguished from cinder and flyash, consists of finely divided carbon and soot particles. These particles come into being when decomposed hydrocarbons issuing from the fuel bed fail to burn completely because of (1) insufficient oxygen (2) inadequate turbulence or mixing (3) a combination of 1 and 2. Here is where overfire jets get in their work.

There are two types depending on where they draw their primary force: (1) blowers to give *both* additional air and turbulence (2) steam jets to give turbulence only, or both turbulence and additional air depending upon location of steam nozzle in air tube.

As far as selection of type goes blowers have cheaper operating costs as air movers than do jets. Where a boiler operates with little or no makeup blowers are almost the obvious choice. Steam jets apply where (1) there are no blowers (2) initial cost of blowers seems prohibitive (3) only turbulence is needed.

As for service, no overfire jet can overcome poor firing practice. They are no cure-all. But as a supplementary tool or a source of auxiliary overfire air they prove most helpful.

General Operation. Bear this in mind. Installing jets is useless unless one of the following conditions applies: (1) reliable automatic jet controls—preferably electronic (2) a situation requiring continuous operation of jets (3) a convenient indication for acquainting the fireman with the density of flue gas. No fireman will or could be expected to operate jets only as needed.

Now let's get about the job of choosing a jet-system design for a working boiler, Fig. 1. Tables II and V give the steps but we'll follow through. We need to know (1) maximum burning rate per sq ft of grate area per hr (2) percentage of overfire air required (3) distance from walls that jets must blow to penetrate smoking areas—so-called length of penetration (4) heating value of coal.

Maximum burning rate comes from observing hourly rate of coal consumption under peak load and dividing by grate area in sq ft. For our example it is

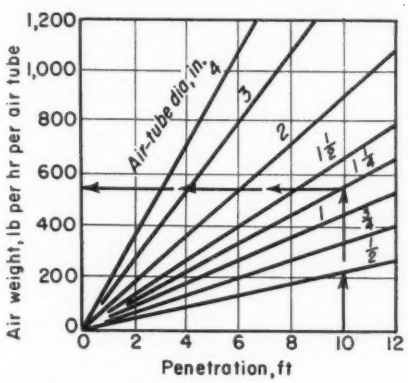
$$\frac{\text{2000 lb coal per hr}}{\text{80 sq ft}}$$

or 25 lb per hr per sq ft.

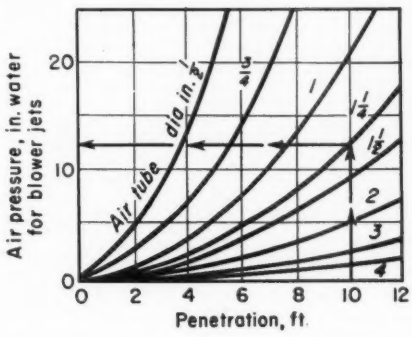
Second, the percentage of overfire air

* Material is developed from Technical Report No. VII—"Application of Overfire Jets to Prevent Smoke from Stationary Plants," by R B Engdahl, Battelle Memorial Institute, and W S Major, Bituminous Coal Research, Inc.

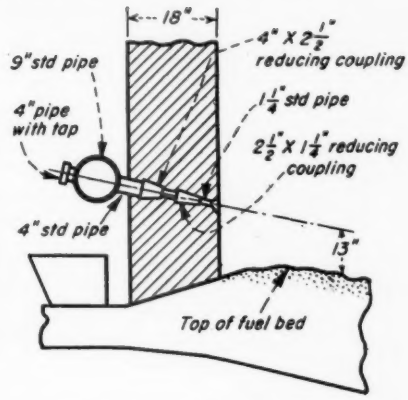
and Sizing to Get Efficient Overfire Action in Stoker Furnaces



3 Knowing penetration length and tube dia get weight of air per tube above



4 Using same factors as Fig. 3 determine required air pressure at tube



5 Locate air tubes on tube spacing above bed; aim 6 in. above on back

Be Made to Cut Smoke*

I: Center-Line Spacing of Air Tubes*

Penetration length, ft	Air-tube diameter, in.					
	0.5	1	1.5	2	3	4
4	5	5	6	7	8	9
6	7	7	8	9	10	11
8	10	10	11	12	13	14
10	12	12	13	14	15	16
12	15	15	16	17	18	19
14	17	17	18	19	20	21
16	19	19	20	21	22	23
18	22	22	23	24	25	26
20	24	24	25	26	27	28

* To nearest inch

II: To Choose Blower Overfire Air Jets

a. Estimate maximum burning rate per sq ft grate area per hr
b. Estimate percentage of overfire air required
c. Estimate length of penetration required
d. Determine heating value of coal burned
e. Determine air-tube diameter
f. Determine air-tube spacing
g. Calculate number of air tubes required
h. Determine weight of air per tube
i. Determine air pressure for blower
j. Calculate total cu ft air per min to inject into furnace
k. Determine cross-sectional area of ductwork needed
l. Don't let any jet impinge on furnace wall or live coal

required: Here a guide chart based on experiments comes to aid. It shows the following:

Smoke density	*Estimated percentage overfire air needed*
Light	10
Moderate	20
Heavy	30

Only in cases of extreme smoking is more than 30% overfire air needed. As much as 35% overfire air is not too much if dense but infrequent smoke develops when, for instance, the fuel bed is manually disturbed during cleaning. But the larger the percentage of excess air needed the more important that the jets operate only as long as needed. For our example, we'll assume moderate smoke and 20% overfire air.

Third point—length of penetration usually equals grate length if overfire jets are in the front wall; grate width if in side walls. Our case has them in the front wall of furnace, and length of penetration is 10 ft.

Heating value of coal comes from (1) recent analyses of coal burned (2) typical analyses of coals from the same mine or bed (3) coal suppliers. Our example uses 13,000 Btu per lb coal.

Fig. 2, solid line, employs the four points (Table II, a-d) we have just determined to give air-tube diameter. Table I gives recommended center-line spacing of air tubes.

But how many tubes do we need? This is determined by dividing the inside length of the furnace wall in inches by distance of air-tube spacing and subtracting one. Convert fractions into nearest whole number. Example:

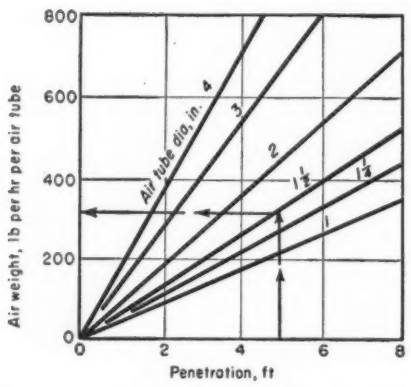
$$\frac{8 \text{ ft} \times 12 \text{ in. per ft}}{13\text{-in. tube spacing}} - 1 = 6 \text{ tubes}$$

Fig. 3 takes into account the length of penetration and the air-tube dia to give the lb per hr of air to be delivered by each tube—560 lb per hr. Fig. 4 uses these same factors to determine air pressure required at air-tube entrance, 13 in. of water.

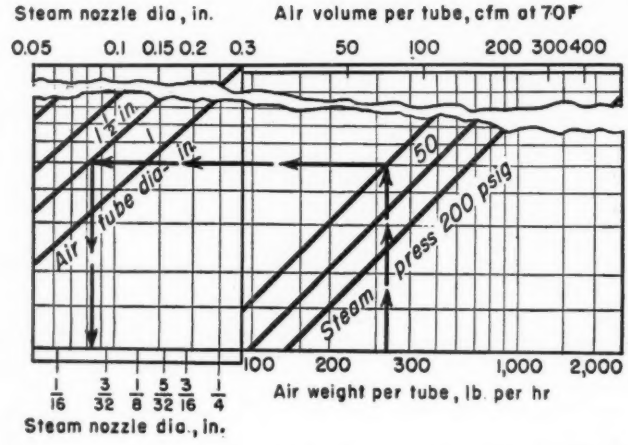
Total air-weight requirements of all tubes must be converted to the same terms by which fan and blower manufacturers rate equipment. By use of a conversion factor .222 in a formula, this can be done. For example: No. of air tubes x weight of air per tube per hr x .222 equals cu ft of air per minute at 70 F, or 746 cfm in our case.

The air pressure, 13 in. of water, required at the air-tube entrance may also be used for blower discharge pressure. But duct velocity must not greatly exceed 2000 fpm for this to be true, and there can't be any sharp bends or abrupt area changes in the duct work. Again, an established formula employing a conversion factor of .072 comes to the rescue to give the required cross-sectional area of the duct

STEAM JETS: Simplified, Step-by-Step Procedure for Selection



6 Air injected per tube per hr with steam jets can be found from above



7 Proper size of steam nozzle required comes from applying known air weight per tube, steam pressure and tube size

III: Pounds of Overfire Air Needed per Pound Coal Burned for Different Smoke Densities

Heating value of coal, Btu per lb	Density of smoke		
	Light	Moderate	Heavy
10,000	.75	1.5	2.25
11,000	.82	1.65	2.47
12,000	.90	1.80	2.70
13,000	.98	1.95	2.92
14,000	1.05	2.10	3.15

IV: Performance of Steam-Air Jet Consisting of 1-In. Air Tube Equipped With 3/32-In. Dia. Steam Nozzle

Pressure of steam supplied to steam nozzle, psig	Length of penetration of jet stream, ft	Pounds of air injected into furnace per hr
15	3	125
25	4	160
40	5	210
55	6	250
70	7	290
85	8	325

between fan discharge and air tubes to hold velocity down to about 2000 fpm under a pressure of 13 in. water. The formula is maximum output of fan in cfm at 70 F (746) x .072 and it equals 53.7 sq in.; the required cross-sectional area.

An 8-in. dia duct has a cross-sectional area of 50.3 sq in. and a 9-in. duct has 63.6-sq-in. area. The first results in a top air velocity of 2137 fpm, and the second 1695 fpm. Either is satisfactory.

Air tube and header duct may be constructed of standard pipe and fittings with no sharp bends or abrupt changes in cross-sectional area. Fig. 5 shows a suggested assembly.

Steam-Air Jets. So much for the blower type; now for the steam-air jets. Here we'll use a furnace 5 ft long with a grate 5 ft wide. We'll have coal of 13,500 Btu per lb, maximum coal burned per hr, 875 lb; smoke density, heavy; jets in the sidewall, and available steam pressure 50 psig.

Our first four factors, Table V, are (1) maximum burning rate per sq ft per hr—875 lb coal per hr ÷ 25 sq ft grate area, 35 lb (2) overfire air required—from guide, p. 79,—30% (3) length of penetration—5 ft (4) heating value of coal—13,500 Btu per lb.

Air-tube diameter comes from Fig. 2, dotted line, and is 1.5 in. Tube spacing shows on Table I, but this table applies only to the nearest inch. If air-tube dia from Fig. 2 shows less than one in., use the alternate procedure to be discussed later. Our example with a 5-ft penetration length and 1.5-in. tube dia falls between 6 and 8 in., or 7 in.

Number of air tubes is arrived at just the same as above and it proves to be 8:

$$\frac{5 \text{ ft x } 12 \text{ in. per ft}}{7 \text{ in. tube spacing}} - 1 = 7.57$$

With sidewall location, put end jets in about one-jet spacing, 7 in. from the inside faces of front and bridgewalls; then space remaining six at equal distances between them. An alternate possibility if both sidewalls are accessible is to locate 4 jets in each wall and stagger them with the opposite side.

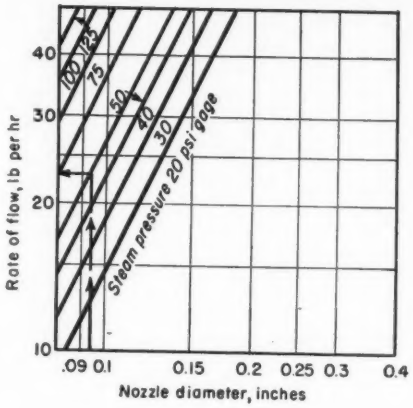
Fig. 6 employs penetration length and air-tube size to determine air weight injected in the furnace per tube per hr—approximately 325 lb.

Fig. 7 provides the guide for proper steam-nozzle size. Using the various figures for the example at hand the chart calls for a steam nozzle of slightly less than 3/32 in. dia. Recommended choice is a 3/32-in. dia nozzle to avoid plugging, which may occur with smaller-sized nozzles.

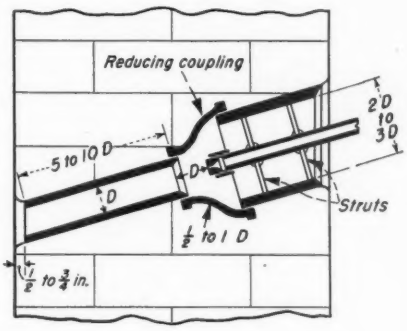
Steam consumption can be estimated with the aid of Fig. 8. As an example, consider the 3/32-in. (.094 in.) nozzles above. They use 50-psi steam and consume 23 lb per hr per nozzle. For eight this amounts to 184 lb per hr of steam if jets operate continuously. With a coal-burning rate of 875 lb per hr, the example given generates a total of 7500 lb per hr of steam. This means jets consume 2.5% of total output if they operate all the time. If they work only 30% of the time they use only 0.75% of boiler output.

Alternate Procedure. Where Fig. 2 calls for an air-tube diameter of less than one inch a different procedure applies. Use only 1-in. dia tubes along

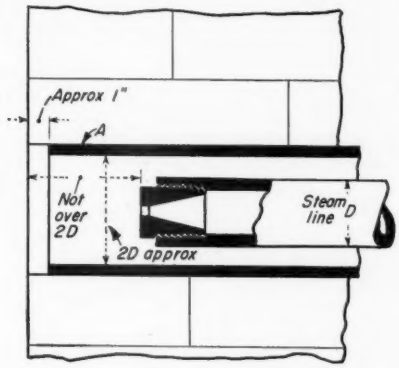
and Sizing to Get Effective Overfire Action in Stoker Furnaces



8 Effect of different steam pressures on flow through nozzles shows here



9 Where air-tube length runs less than wall thickness, follow this method



10 For turbulence alone steam-jet arrangement shown is recommended

V: To Choose Steam-Air Jets Properly

a. Estimate maximum burning rate per sq ft of grate area per hr
b. Estimate the percentage of overfire air required
c. Estimate length of penetration needed
d. Determine heating value of coal burned
e. Determine air-tube diameter required
f. Determine air-tube spacing required
g. Calculate number of air tubes required
h. Calculate weight of air per tube
i. Determine the steam-nozzle diameter
j. Make air-tube length between 5 and 10 times its diameter
k. Keep nozzle centered and aligned with axis of air-tube dia back of throat
l. Arrange for air to flow into air tube as smoothly and gradually as possible
m. Design silencers
n. Don't allow any jet to impinge on the furnace walls or burning coal

with $\frac{3}{32}$-in.-dia steam nozzles, Table IV.

Let's set up an example: Take a stoker-fired hrt boiler with a grate 5 ft long by 3 ft, 6 in. wide and a furnace height of 3 ft burning 350 lb of 13,000 Btu coal per hr at maximum rating and giving off a moderate smoke. Available steam pressure is 50 psig.

Calculate total weight of overfire air required per hr by multiplying (1) maximum coal burned per hr (350) by (2) lb of overfire air required per lb of coal burned, from Table III (1.95) and we find 683 lb of overfire air required per hr.

Next, determine weight of air injected in the furnace per tube per hr if tubes are placed in the sidewall to give a 3-ft, 6-in. length of penetration, and steam supplied to the nozzle is at 20 psig. For a one-in. tube, air injected in the furnace from Table IV by interpolation will be 143 lb per hr per tube. It may be well to say at this point that if available steam pressure is higher than the nozzle requires, a reducing valve must be used to supply the lower pressure.

Here, total number of air tubes required is determined by dividing total weight of overfire air (above) by weight of air injected per tube per hr, or 683 ÷ 143 gives 5 tubes.

If all five tubes go in on one side they should be equally spaced with end tubes at least 6 in. from the adjacent end walls. The five tubes could be put in both walls, 3 on one side, two on the other, and staggered with the opposite side tubes.

Construction Details. Fig. 9 shows the important features of construction of a steam-air jet. Air tube can be made of standard pipe. The smooth, rounded or funnel-shaped approach to the air tube can be formed of plastic refractory or a pipe coupling, reducing from at least two sizes larger than the air tube down to air-tube size.

The steam nozzle may be made from a standard pipe cap or plug. A drilled hole forms the nozzle bore and should be countersunk to provide smooth flow into the nozzle. Alloy cast iron or heat-treated high-chromium, medium- or high-carbon steel makes a nozzle material that resists erosion and gives long life under this service.

Proper control and operation depends upon building into the system valves and steam gages. They provide a ready means of holding steam pressure to the desired point and shutting off jets when not needed. Hand-controlled purging valves or traps remove moisture from the lines.

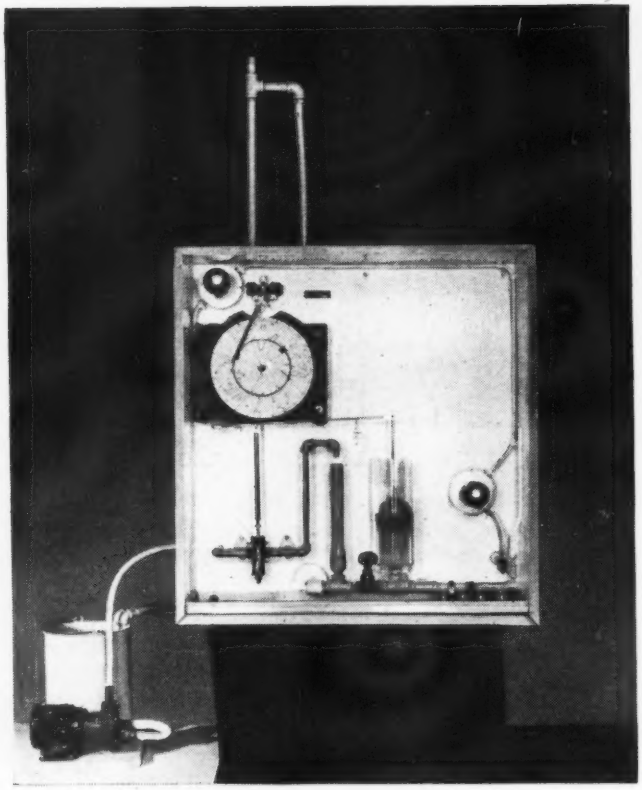
Unmuffled steam jets give off a disturbing noise. There are several designs of mufflers both concentric and suspended that have been worked up to reduce this nuisance. In our next article, in an early issue, on the application of overfire jets to particular designs of furnaces and stokers we will illustrate some of these muffler arrangements.

Where only turbulence fits the bill, steam nozzles may discharge directly into the firebox instead of into the throat of the air tube. And here's how that is accomplished.

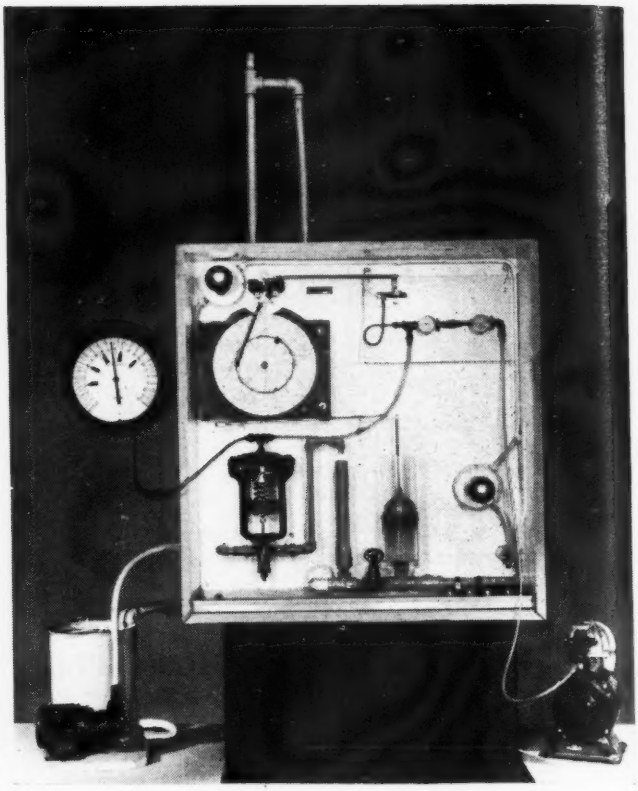
Ordinarily the steam nozzle discharges directly into the firebox instead of the throat of an air tube. It gives nearly as much penetration without an air tube as with it.

But it is not practicable to install jets with air tubes and then stop the air inlet if it is found later that air is unnecessary. A vacuum forms in the air tube and penetration becomes almost nil. In a case like this extend the steam line through the air tube so the nozzle discharges near the air-tube outlet. Whatever small amounts of air flow through the air tube, under natural draft, keep the steam nozzle cool when not in use. Fig. 10 shows just such a nozzle assembly.

Our next article discusses the recommended application points for various stoker arrangements.



1 In first step, panel contains a recording pen and float-operated valve that controls water flow to the small tank



2 Instead of self-acting controller in Fig. 1, the float throttles air discharge from nozzle to position the valve

Working Model Simplifies Theory

New employes get basic control fundamentals by assembling a controller step by step to learn how it works. Here is the start of a 2-part lecture used by G F Akins, instrument engineer, engineering and maintenance dept, Eastman Kodak Co

► FUNDAMENTAL PURPOSE of automatic controllers, Fig. 1 and 2, is to maintain a balance between the input and output of a process.

For example, water feeds into the tank, Fig. 3, through valve *A* and out through *B*, and we want to control the level at a fixed point. For an indicator, install a float, which rides on the water surface, and connect it to a pointer. If input through valve *A* balances output through *B*, the level stays at desired point on the scale.

If output is increased by opening *B* slightly, more water flows out than in, and the level falls below the desired control point. To return the level to normal control point it is necessary to open *A* to balance the new outflow. In a nutshell, this balancing of input against output demonstrates the principle of automatic control.

Fig. 4, a typical water-heating hook-up, shows the similarity between liquid level and other control problems. Steam flows in through valve *A* to a heating coil, and out through a trap. Cold water flows into tank bottom, is heated, and flows out through *B*. Input to this equipment is the heat supplied by the steam, and output the heat given to the water. To check water temperature we can install a bulb and bourdon-spring indicator.

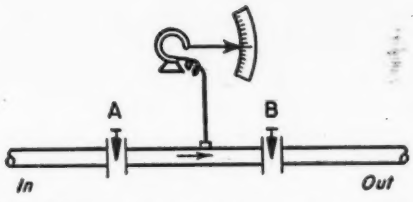
Effects of Flow Change. If we admit enough steam through valve *A* to heat the water to a desired temperature, the process balances and the pointer shows that we have reached the desired control point. If we open *B* slightly and allow more water to flow through the tank, with a constant supply of steam being fed to the coil, the water will not remain at the original temperature. At the lower temperature, the thermal bulb exerts a lower pressure, the bourdon spring partly collapses, and the pointer drops on the scale. This is an example of *temperature level* control.

Returning to Fig. 3, we see that both systems behave in the same manner: An increase in output causes the indicator pointer to fall.

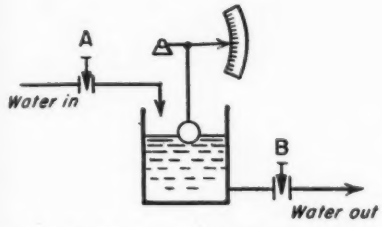
Now consider the pressure controller in Fig. 5. Here we want to hold a desired pressure in the pipe between valves *A* and *B*. By throttling *A* to balance the resistance created by *B*, a definite pressure can be maintained. Connected to the line is a bourdon spring and pointer to indicate pressure.

Pressure Change. If *A* is adjusted to

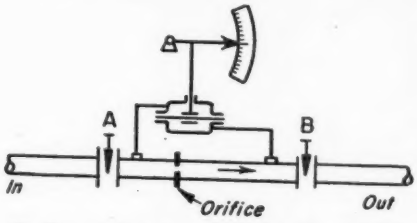
Input Must Be Balanced Against Output to Maintain the Desired Level



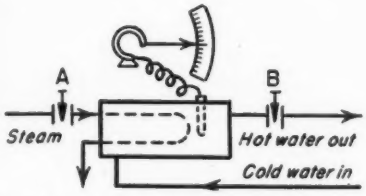
5 Pressure in a line remains constant as long as inflow balances discharge



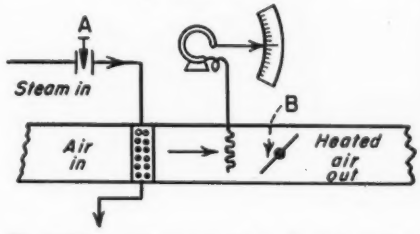
5 If liquid input balances discharge, the level stays at the desired point



6 To control flow we measure the differential pressure across an orifice



4 With a constant supply of steam and water, temperature remains steady



7 With a set steam flow, changing the damper B upsets the air temperature

Of Automatic Control

balance a specific opening of *B*, the *pressure level* of the system (pressure inside the pipe) remains constant and the pointer stays at the desired control point. Opening *B* to increase the outflow decreases the resistance to flow at this valve and the pipeline pressure falls. Reduced pressure causes the bourdon spring to collapse partly and the pointer drops on the scale. Thus an increase in output has the same effect as it did on the liquid-level and temperature systems.

Fig. 6 illustrates a simple flow-control system, where flow is measured by the differential pressure created by an orifice in a pipe. The mechanism above the orifice is a diaphragm connected between the high- and low-pressure sides of the orifice. A change in differential pressure across the orifice causes the diaphragm to move and position a pointer on a scale.

If valve *A* is set to balance a specific outflow through *B*, the system is in balance and the pointer indicates the flow rate or *flow level* on the dial. Opening *B* to increase the outflow rate lowers the resistance at this valve, so downstream pressure at the orifice decreases, and differential pressure across it increases. Diaphragm then moves downward and lowers the pointer. As before, an increase in outflow causes the pointer to fall away from the original control point because input and output resistances are unbalanced.

In Fig. 7 a bulb and bourdon spring measure the temperature in an air-heating system. If the proper amount of steam is admitted through valve *A* to balance a specific air flow past damper *B*, a constant temperature is maintained in the system. If the damper is opened to increase outflow, air temperature will drop.

We have investigated five basic-control systems, and found that the fundamental of *balancing input against output* to maintain a desired level applies to each.

In each system described, valve *A* had to be adjusted by hand to regulate the input to balance the output. Observing the relationship of tank level to the flow through this valve, in Fig. 3 we can link the valve stem to the float so any change in water level repositions the valve and regulates input flow, Fig. 8. This device could then be called a *self-acting regulator.*

Throttling Range. Choosing the point of maximum tank level we fix the linkage so the valve will be fully closed at that position. The lowest permissible tank level is then selected and the lever system arranged to open the valve fully at that point. Open and closed positions of the valve then correspond to the extreme points on the dial scale in Fig. 8. This span of travel can be labeled the "throttling (proportional) range."

To provide true proportional action, we design the valve port to throttle the flow in proportion to position of the stem, which in turn is positioned by the lever acting as the indicator pointer. With the pointer at mid-scale, the valve delivers 50% flow. For any other percentage of stem travel, flow is in direct proportion to pointer position. The device has now become a "proportional-type" controller.

Assuming that flow out through valve *B* is 50%, we can adjust the leverage and control valve to produce an equivalent flow of 50% and the system is in balance. The pointer stands at 50 on the dial and represents the desired control point. Now suppose the load or outflow is increased to 75%.

Rebalancing. As tank level drops the float opens the valve to increase input flow. This rebalancing action continues until the valve opens far enough to supply the 75% load. System then reaches a new balance and the level remains constant. The pointer, however, is not at the original or desired control point, but has gradually dropped to the "75" mark on the dial. Operation of this self-acting proportional valve is typical of all proportional controllers; they restore balance following a load change, but the measured level must change to reposition the valve for the new flow rate.

To show that a temperature-control system behaves in like manner, consider Fig. 9, which shows the previous water heater controlled by a self-acting device.

In the proportioning self-acting pressure controller, Fig. 10, pressure in the line under control is fed back to a diaphragm top. This in turn positions the valve to regulate flow. As long as the load through valve *B* is 50%, the controller maintains the desired pressure in the pipeline.

Reviewing the three systems just

described it is evident that the same principles apply to all types of self-acting controllers: (1) Throttling range is determined by amount of deviation of the measured variable required to cause the valve to move from minimum to maximum position. (2) A load change causes the pointer to deflect from the original setting. This action, known as "offset from control point" is required to rebalance the controlled valve following a load change.

Self-Acting Unit. To demonstrate the operation of a self-acting controller let's look at Fig. 1. A small pump lifts water to a constant level above the panel to provide constant pressure to the float-controlled input valve, which regulates water flow according to its position. On leaving the valve, the water passes up and over a pipe loop that maintains constant backpressure on the valve.

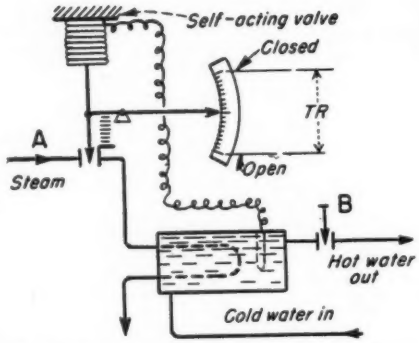
The water now passes down a supply tube into the transparent tank, whose water level is the variable to be controlled. The ball float controls the valve and moves the chart pen through a system of linkages. Water leaving the tank passes out through one or more petcocks in the discharge pipe on the panel bottom. Each petcock has a discharge of 25% of total flow; opening all four valves gives a flow of 100%. Throttling range of this device is 100% of the chart to move the valve from closed to open.

Opening two of the loading petcocks to set the process load at 50% we can adjust the control-valve stem so input flow balances output when the pen shows "50", or midpoint on the chart. The self-acting device will provide stable control under this load.

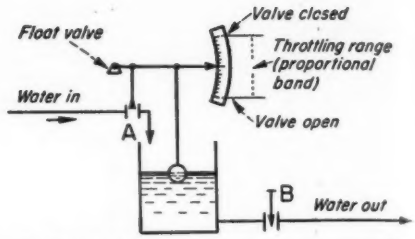
The chart bears a color band at mid-range to indicate a required control band of plus or minus two points (inches, feet, etc). Our aim is to control the tank level so the pen stays within the color band.

With the control operating satisfactorily at 50% load, let's change it to 75% and observe controller action.

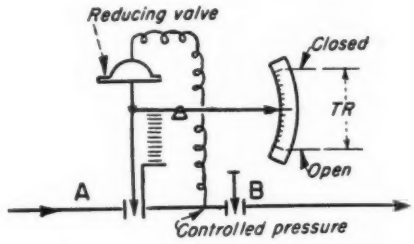
Self-Acting Controllers All Operate on the Same Basic Principles



9 Self-acting controller moves steam valve according to water temperature



8 Proportional range in a controller is off-to-on range in valve travel



10 Self-acting controller uses pressure in line to operate diaphragm valve

As load is increased, water level begins to drop and causes the valve to open wider. When the valve reaches 75% flow the process is again in balance, but the recording pen has dropped to the 75 mark on the chart. The system is again in stable control but not at the desired control point. A corresponding deviation of the pen would occur if the load were set at some other load, such as 25%.

As we reset the petcocks to return to 50% load the level in the tank begins to rise. As it reaches the original position, the control valve will be delivering 50% flow and the system will again be in balance. The pen has now returned within the color (control) band.

Because of friction between the stem and stuffing box the force exerted by the float is too small to position the valve accurately. This condition exists in many types of self-acting devices except self-actuated pressure controllers.

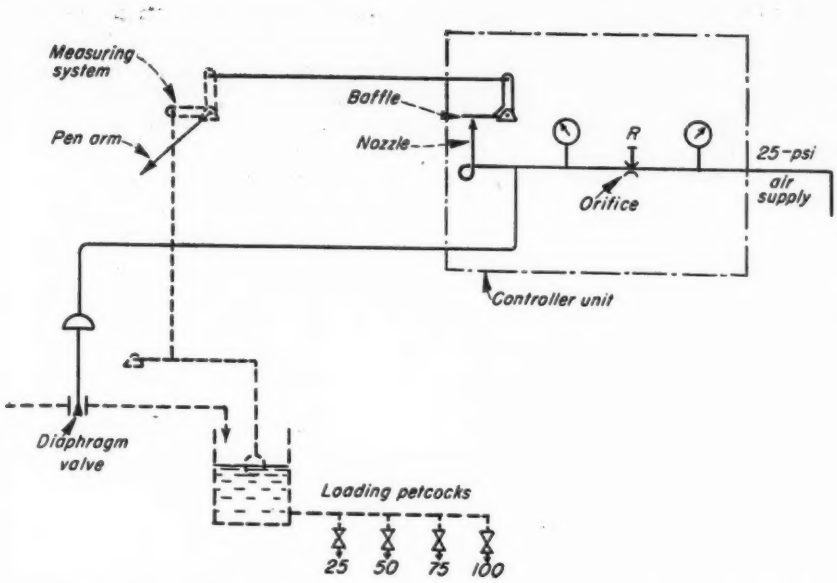
For instance, if we design a temperature controller to be operated by a bourdon spring, we would find the force developed by the spring to be in terms of flea power. Such a small force could hardly be expected to position a 6-in. steam valve. We must utilize power from some external source to move the valve, and the transmission medium should permit locating the valve some distance from the controlling unit.

We could mount electric contacts above and below the float arm. As the level rose, the upper contacts would close, and the current cause a motor-driven valve to close. As the level fell, the lower contacts would close to reverse the motor, and open the valve. Such a control produces *on-off* action and is suitable for some installations, such as an extremely large tank wherein the valve could open and close yet cause only a slight change in liquid level, or the heating of a large tank of water, where there is large heat-storage capacity within the system.

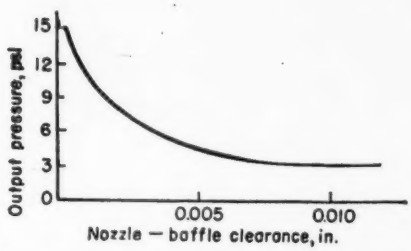
Pneumatic Controller. Going a step farther, let's design a valve that can be operated by compressed air. The flexible diaphragm with its pusher plate offers a simple means of converting air pressure to mechanical motion, such as pushing a valve stem. Air pressure applied to diaphragm top moves the stem downward and opens the valve. A spring below the pusher plate opposes this action and tends to close the valve. Since spring deflection is directly proportional to the applied force, downward motion of the valve stem is directly proportional to air pressure on the diaphragm. We will now select a spring strong enough to hold the valve at its topmost or closed position when

OPERATING DATA OF THE NOZZLE-BAFFLE SYSTEM

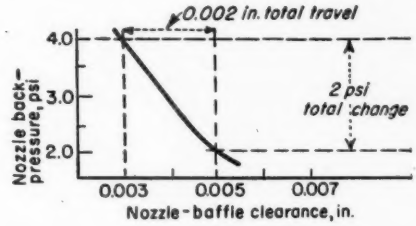
Nozzle-baffle clearance, in.		Output pressure from controller, psig		Control-valve position
0.0005	Total range, 0.011 in.	15	Total range, 12 psig	100% open
0.0010		12		75% open
0.0015		9		50% open
0.0030		6		25% open
0.0115		3		Closed



11 Air at 25 psi flows through orifice to the nozzle where discharge is throttled by a baffle actuated by float arm. Branch line goes to diaphragm valve



12 On-off controller output plotted against nozzle-baffle clearance



13 Curve of small nozzle with low back-pressure is more linear than Fig. 12

3-psi pressure is applied to the diaphragm. And as diaphragm pressure is increased to 15 psi, will let the valve travel downward to its full open position. The full valve stroke in this demonstration is ½ inch.

The design can be modified to meet various requirements such as *air to open* or *air to close* and by increasing the diaphragm area, sufficient force can be obtained to operate extremely large valves or dampers. Connecting tubing can be run for a considerable distance to permit remote valve operation.

Our next problem is to design a controller to modulate the air pressure to the valve according to some measured variable, such as temperature or liquid level.

We all know that blocking the flow from an open nozzle causes an increase in backpressure within the nozzle. To apply this scheme to a controlling device let's use a small nozzle and hinged baffle or flapper. Supply air will be fed to the nozzle through a short length of tubing containing an orifice restriction. As the flapper is advanced toward the nozzle, backpressure inside the nozzle increases because the orifice is supplying more air than can escape from the nozzle. If the flapper is moved away, more air escapes from the nozzle than is supplied by the orifice and nozzle pressure decreases. A range of backpressures of 3 to 15 psi can thus be obtained by moving the flapper a very small distance.

Suppose we connect the baffle to the measuring element of the instrument, which may be a bourdon spring, bellows or diaphragm. Here the *flea power* of a bourdon spring is enough to position the baffle against the nozzle.

In Fig. 11 we have an air-operated device with the float-arm motion mechanically transmitted to the control unit. Considering the float mechanism and recording pen arm as the *measuring system* of the instrument, once the variable has been measured, pen motion can be used to operate the controller mechanism. Any instrument, whether it measures temperature, humidity, conductivity or pH, contains two major parts; the measuring system and controlling mechanism. Fig. 11 purposely shows these units as separate assemblies.

Supply air at 25 psi comes in at right of controller, passes through orifice *R*, and then to the nozzle on left side of panel. A branch from the nozzle line connects to the diaphragm valve in the lower left-hand corner. A baffle above the nozzle connects by linkages to the pen arm of the measuring system. Pen movement raises or lowers the baffle and thus restricts, in varying amounts, flow from the nozzle.

Assume pen arm moves to the right. The baffle will fall and restrict discharge from the nozzle. Since more air feeds through the orifice than bleeds from the nozzle, pressure in the nozzle line will increase to 15 psi and open the diaphragm valve. If the pen arm is moved to the left, baffle is raised and thus uncovers the nozzle. More air bleeds out the nozzle than is admitted through the orifice; hence pressure in the nozzle line drops to 3 psi. Diaphragm valve will then be fully closed.

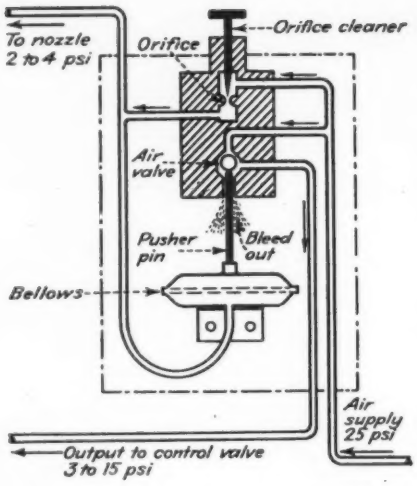
At first glance, this rather simple device appears to answer our need for a modulating controller to position the diaphragm valve. Let's set the loading petcocks for 50% flow and observe the behavior of the system, Fig. 2.

Cycling Operation. Wavy lines on the chart indicate that output air pressure is cycling from one extreme to the other and the recording pen is drawing a line first above and then below the color band. This shows the process requires a control unit with greater proportioning action than is obtainable with a simple nozzle-baffle assembly, because such a device is an on-off controller.

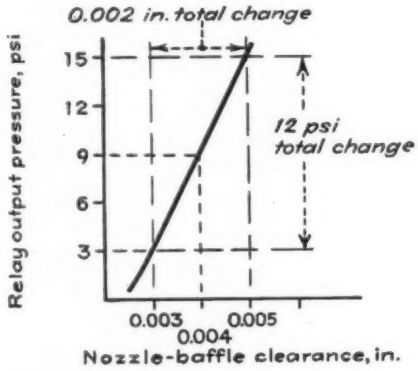
To produce a controller having a wide throttling action we must develop an entirely new mechanism. As a starting point, let us examine in detail the operation of the nozzle-baffle system to determine the factors responsible for the *on-off* action just experienced.

Experimenting with the nozzle assembly we find, for every setting of the clearance between nozzle and baffle, a corresponding backpressure developed at the nozzle. For instance, if clearance is 0.0005 in., backpressure is 15 psi. Increasing clearance to 0.001 in. causes backpressure to drop to 12 psi. By making a series of settings and noting the corresponding backpressures, we get the data in the table.

Inspection of this table reveals the reason for lack of proportional action in the *on-off* unit. For very small changes in nozzle-baffle clearance, such as changing the clearance from 0.0005



14 Amplifier or relay valve transforms nozzle impulse into high pressure



15 Combination nozzle and relay, Fig. 14, gives an almost linear response

to 0.0015 in., causes backpressure to drop from 15 to 9 psi and move the controlling valve from full-open to 50%-open position. The valve has thus been moved through half its stroke by a slight baffle motion, one-thousandth of an inch.

Mechanism Backlash. Linkages between the recording pen and baffle must be entirely free of backlash or lost motion if the baffle is to be accurately positioned to match the pen arm's position. In building such a linkage we would undoubtedly introduce friction because of tightly fitted pivots. As we sought to reduce friction, the problem of lost motion would again appear.

After rebuilding the linkage system, we would conclude that the scheme was impracticable for a commercial-type controller and would turn to some means of obtaining greater baffle travel to lessen the effects of lost motion. By increasing baffle movement to 0.25 in., we could permit an accumulated lost motion of 0.001 in. with little effect upon instrument accuracy. This would permit manufacturing linkages within practical tolerances.

Another fault in the *on-off* design is evident in the table. A change in nozzle-baffle clearance of 0.0005 in. causes an output change of 3 psi at one point while at another a change of 0.0085 in. is required to produce an equal change in output. This represents a 17 to 1 ratio in the rate of response. In other words, if output pressures were plotted against nozzle-baffle clearance, the resulting plot would be a nonlinear curve, Fig. 12.

Such nonlinearity cannot be permitted if the controller is to be truly proportional in its response.

Further experimentation with the baffle mechanism reveals that whenever backpressure at the nozzle reaches the upper limit, jet effect from the nozzle lifts the baffle slightly, causing an erroneous response in controller action. To overcome such a condition it appears logical to limit backpressure to a relatively low value, such as 4 or 5 psi.

Orifice Restriction. As a final step in our analysis, consider the capacity of the *on-off* device to supply air to a large diaphragm valve. We find the orifice employed to restrict air flow to the nozzle also limits the quantity of air delivered to the diaphragm. Flow rate to the valve being slow, its response will be sluggish. To get rapid valve action, we have to use some form of booster air valve. The design of a truly-proportional controller should, therefore, include the following features:

1. The baffle should have a total movement of at least 0.25 in. to compensate for lost motion in the linkages.
2. Output pressure should change proportionally with baffle movement because its position corresponds directly with that of the pen.
3. Nozzle backpressure should be low (maximum of 4 or 5 psi) to improve the linearity of response and to minimize baffle deflection.
4. Controller should have ample output capacity to rapidly inflate large valve diaphragms.

As a starting point in designing an improved controller, let's see how a small-diameter nozzle acts when operated under low backpressures. Experimenting with a nozzle diameter in the range from 0.020 to 0.030 in. and a restricting orifice of about 0.011 in. we can plot backpressure versus nozzle-baffle clearance, Fig. 13.

It is evident that the response curve is far more linear than that obtained with the previous design where the full range of 3 to 15 psi was impressed on the nozzle. We get the greater linearity by using an extremely small pressure change; that is, the smaller the increment of change, the nearer the response will approach straight-line performance. It appears, however, that we are now dealing with extremely small changes in nozzle-baffle clearance because total change represented on the graph is only 0.002 in. Naturally, such minute movement cannot be tolerated if controller action depends solely on a clearance change. But as our design continues, we will discover that such small deviations can be used advantageously.

Air-Relay Valve. To make use of the improved linearity of the low-pressure nozzle, yet provide the desired air-pressure range to the control valve, we conclude that an amplifier or air relay, Fig. 14, is required to transform the nozzle impulse of 2 to 4 psi into an output range of 3 to 15 psi.

Supply air is admitted on the right side and feeds two branches, one to the orifice, another to the air valve. The orifice restricts flow of air to the nozzle as in the previous designs, but here the air line leaving the restricting block branches out to feed both the nozzle and a small bellows below the air valve.

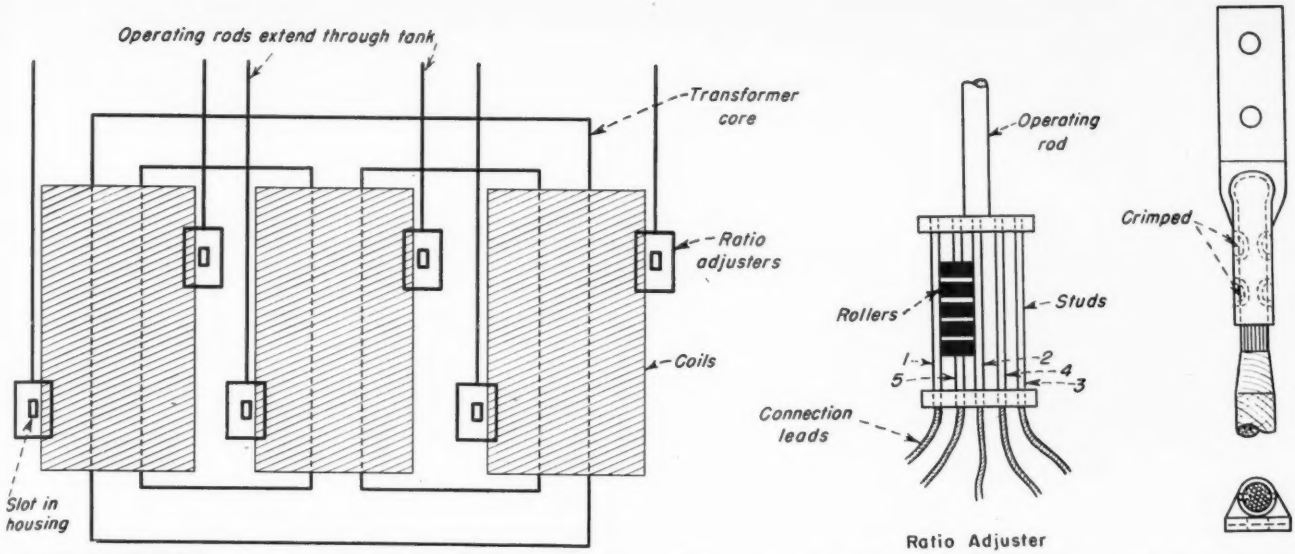
In this design any change in nozzle pressure causes a pusher pin, attached to top of bellows, to position a small ball between two seats, the upper seat being the supply port, the lower seat acting as an exhaust port. As the ball assumes a position between the two seats, a given amount of air flows in the supply port and a corresponding amount flows out the exhaust port.

The resulting pressure created in the valve chamber varies with the ball's position, hence this pressure can be utilized as the output from the relay. An air tube connects the air-valve chamber with the final control valve and is labeled output. Capacity of the supply and exhaust ports can be made large enough to meet the demand for rapidly filling a large-diaphragm chamber.

Such a relay converts the small impulse received from the nozzle to an output pressure of the desired magnitude. Graph in Fig. 15 combines the characteristics of a low-pressure nozzle and relay.

The improved linearity of response, as obtained with the low-pressure nozzle and relay, will assist greatly in the final performance of our proportioning controller.

Second part of this article will design a system of mechanical linkages that uses bellows motion to position the nozzle and apply this mechanism and other refinements to a proportional controller.



RATIO ADJUSTERS are located adjacent to transformer windings and connect by wood operating rods to external handles. After adjuster froze in position, quick repair was made by cutting it free and installing tap jumpers with solderless crimp lugs

Crimp Lugs Speed Transformer Repair

By K B HOFFMAN
Engineer, Burns and Roe, Inc.

▶ WE RECENTLY FOUND ourselves in a tough spot because of trouble which developed in the ratio adjusters of our power transformers. We have three 5000-kva, 27,000/13,600-v, single phase, oil-insulated outdoor transformers in our plant, which are grouped for bank operation. Ratio adjusters, in each coil group for changing taps while transformer is deenergized, are the bird-cage type, consisting of studs and rollers as shown above.

Ratio Adjuster Detail. Cables connect from taps in transformer winding to individual studs of tap changer. Note cable connections extending through bottom support of ratio adjuster. Springs located inside the rollers exert necessary pressure on studs. Rollers complete transformer circuit by ridging two adjacent studs in tap changer. Micarta enclosure which surrounds ratio adjuster is not shown in above sketch.

Wood operating rods connecting ratio adjusters to external handles extend through cover so taps may be changed without dropping transformer oil level. The only possible way adjusters can be inspected is to drop oil level, sit on top of core laminations and use an adjustable periscope with its own miniature inspection lamp.

Transformer load changed recently and it became necessary to change taps on low-voltage side. When ratio adjusters were operated, two on one transformer required considerable force to turn while another was frozen and could not be moved.

Problem. After taking an oil sample from both top and bottom of transformer in which ratio adjuster could not be moved, we found it dark in color with carbon particles floating in sample. Oil level was then dropped exposing ratio adjusters. Inspection showed a solid mass of carbon covering rollers and studs. In fact, contact surface between both was filled with a quarter inch of carbon residue.

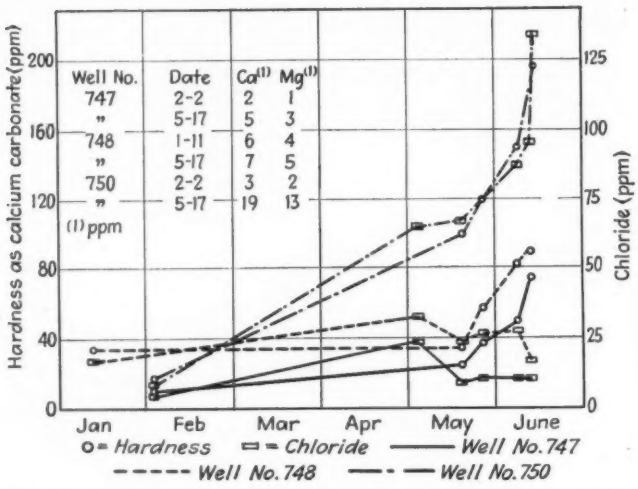
There was a mad scramble to locate replacement ratio adjusters and as luck would have it, none were in stock. Since the contact condition of the ratio adjusters was a potential hazard under load it would be dangerous to put the transformers back in service as they were. High contact temperature or a spark could ignite the oil. The transformer bank had to go back in service as soon as possible since load conditions would not permit an extended outage.

Solution. After some discussion it was decided to connect the proper winding taps for the new voltage and disconnect the ratio adjusters. Tap leads were accessible so they could be cut without removing core and coil assembly from tank. Since the work had to be done inside the transformer and in congested quarters, it was decided that soldering the tap leads together would be a hazard to the men.

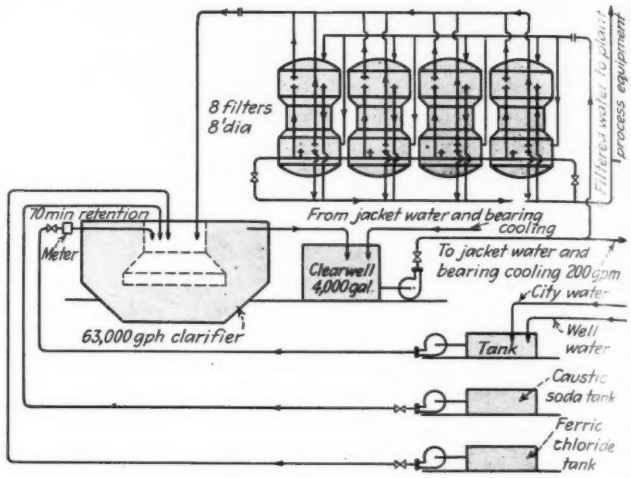
Compression Lugs Used. It was decided to make the connecting jumper using solderless compression lugs. To satisfy ourselves that this type connection would be satisfactory with the many-stranded flexible cable, a lug was pressed on a sample section. A hand-operated hydraulic press was used to exert approximately 8000 psi to press a $\frac{5}{8}$ in. slot along both sides of lug.

A similar section of cable was prepared with a soldered lug. The two samples were given a tension test, pressure being applied between lug end and cable. Sample prepared with the hydraulic press withstood more tension than soldered lug and showed distortion at bolt holes in lug before cable strands pulled free.

As a result we used compression lugs to make tap connections on all transformers and the bank was returned to service in record time. No trouble has been experienced with the installation to date and the transformers have been carrying overloads at frequent intervals. Periodic oil tests showed no color change and no further contamination as evidenced by free carbon particles.



1 Water composition, once the plant got under way in 1935, underwent rapid changes in chlorides and hardness (above)



2 Clarifying equipment includes 40,000-gal tank to collect and mix well and city water. It then goes to the clarifier

Internal Conditions of Old Boilers

Here's a unique approach in planning treatment for new units: A 10-year experience serves as spadework in producing a sound installation

By J N WELSH, H M RIVERS and C J KILDUFF*

▶A SPECIALLY DESIGNED feedwater-treatment system represents a major part of the power modernization program at U. S. Industrial Chemicals, Inc, Curtis Bay, Md. plant (POWER, Feb 1948, pp 64-67). Design for this water-treatment plant drew heavily on a 10-year operating record of internal phosphate treatment of raw-water makeup for two 125,000-lb-per-hr 650-psig 645-F steam generators. When plans called for adding to steam generation with two 240,000-lb-per-hr 650-psig 700-F generators (one already is in operation) this 10-year experience furnished many influencing factors.

Well-Water Composition. Back in 1935 when the 125,000-lb-per-hr boilers went into service, condensate returns were estimated to run 10 to 30% of feedwater needs. Makeup came from nine wells, as shown in Table I, p. 90.

Water from Well 1326 had 15-ppm calcium and 12-ppm magnesium, making it fairly hard. Water from Wells 747, 750, 1325, 1468 and 1469 ran quite soft. Considering the capacities of all wells, a mixture of water from most, excluding 1326, gave a water as low in hardness as hot-process lime-soda-treated water.

Concentrations of iron, aluminum, dissolved solids and suspended material in the well waters figured in early considerations. The over-all picture in a mixture was not alarming except for Well 1326 water, which was relatively high in iron and dissolved solids, and had a concentration of suspended material of 3 ppm, the maximum found. Aluminum concentration was not more than a trace. As for silica, it was recognized that its concentration was high in relation to other constituents, but back in 1935 silica removal was not understood as it is today. Also, barring localized excessive heat input to the boilers, silica was not expected to be troublesome.

Once the plant got under way water composition changed rapidly for the worse, Fig. 1. As time went on further deleterious changes developed in the water.

Feed-Line Deposits. Table I shows the low pH of the well waters. Also, a substantial part of water hardness was due to magnesium, as the ratio of magnesium to calcium was higher than in most natural waters.

Despite thorough deaeration of feedwater, corrosion evidence appeared in feed pumps and regulating valves by the fall of 1935. Some corrosion had been anticipated so it was detected before much damage was done. Arrangements were made to change feeding of caustic soda for maintenance of boiler-water alkalinity so the alkali chemical would be introduced continuously into the boiler feedwater.

Following this change deposits formed in the feed lines and regulating valves. Although magnesium hydroxide, ferric-iron oxide and ignition loss were substantial in amount, magnesium silicate was the main deposit constituent. This compound separates solid phase from high-temperature feedwater containing a fair amount of magnesium and silicate if pH is in excess of about 8.0.

Subsequent adjustments of alkali-chemical feed indicated deposition could be prevented by holding pH at 7.0 to 7.5, and from mid-1941 on the problem was no longer serious. But changes in raw-water composition made close control of pH difficult. A reduction of magnesium concentration in the feedwater was desirable.

Analcite Scale. Analcite (sodium aluminum silicate) first appeared in the boilers in Sept. 1935. From then until pretreating equipment was installed a constant battle was waged to stop formation of this complex-silicate scale. Attempts were made to recover more condensate, but contamination

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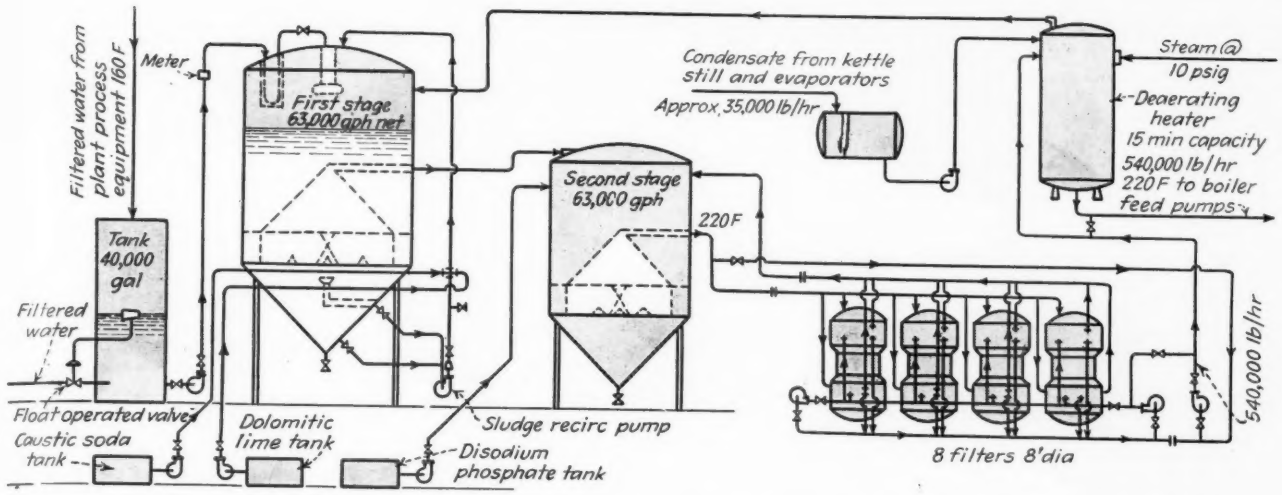

Filtered water from plant process equipment 160 F
Meter
First stage 63,000 gph net
Second stage 63,000 gph
Condensate from kettle still and evaporators
Approx. 35,000 lb/hr
Steam @ 10 psig
Deaerating heater 15 min capacity 540,000 lb/hr 220 F to boiler feed pumps
220 F
Tank 40,000 gal
Filtered water
Float operated valves
Caustic soda tank
Dolomitic lime tank
Sludge recirc pump
Disodium phosphate tank
8 filters 8' dia
540,000 lb/hr

3 Filtered water from plant process pumped through metered, inlet-water controller and vent condenser goes to the spray heater on first-stage hot-process unit. Steam from deaerating heater raises the first-stage makeup water to 200 F

Guide Water Treatment For New Units

from slop evaporators ruled this out. Magnesium sulphate was fed to one boiler to reduce silica concentration, but magnesium precipitated as magnesium phosphate, and phosphate consumption increased too greatly.

Even tannin-feeding was instituted. It did not affect rate of scale formation but it did seem to render deposits more brittle and hence more easily turbined from tubes. After several years its continued use did not seem justified.

Some relief from analcite deposits was gained by (1) discontinuing use of water from some wells (2) increasing capacity of others by rehabilitation (3) installing new pumps (4) making up net loss in water with city water, Table I.

Analcite scale cannot form if aluminum does not get into the boiler water. Because aluminum did not appear in filtered makeup-water samples its source was recognized to be suspended material. In Sept 1944, Well 3700 water became heavily laden with suspended matter and demonstrated the soundness of this thinking. Boiler tubes failed from analcite-scale formation after a boiler had generated only 100 million lb of steam.

For several years boiler tubes had had to be turbined after every 125 to 150 million lb of steam to avoid overheating because of analcite-scale formation. But improvements in makeup quality had extended runs to 400 to 500 million lb of steam between 1940 and 1944. Then came the 1944 experience.

Analyses of raw-water samples in Oct 1944 (Table I) showed less suspended mater in Well 3700 water than was present on occasions in Sept. Nevertheless the 74 ppm of suspended material was sufficient to add 2 ppm of aluminum and 33 ppm of silica to the water. The other well waters contained less but far from insignificant amounts when silica and aluminum concentrations of filtered samples are compared with total concentrations of these constituents. Even city water had a substantial amount of suspended solids containing silica and aluminum.

X-ray examination identified aluminum silicate as sillimanite in the suspended matter of Well 3700 water. The boiler feedwater must have carried considerable suspended matter at the time showed because the scale formed aluminum silicate in relatively small amounts. This would not normally remain as such very long in high-temperature, alkaline boiler water unless it was there in considerable amount.

Pretreatment Found Necessary. Rapid changes in well-water composition indicated the need for pretreating equipment. Removal of suspended material was considered in 1937. Always the hope that further contemplated water-supply changes would obviate the need for pretreatment delayed action.

Hope was abandoned in 1944, and a decision made to install suitable equipment for two reasons: (1) Abnormal contamination of Well 3700 water with suspended material demonstrates the need for clarification. (2) The new 240,000-lb-per-hr steam generator was to be installed, and troublefree operation demanded the best possible water.

Selection of Equipment. The wealth of experience gained in ten years' operation of the 125,000-lb-per-hr boilers simplified selection of equipment. Burns and Roe, Inc, consulting engineers, Hall Laboratories, Inc., consultants on water, and engineers and chemists of U. S. Industrial Chemicals, Inc cooperated in reaching conclusions.

Except for less suspended solids in water from Well 3700 as the result of strainer repairs, Table I, 1944 listing, shows representative analyses on which conclusions were based. Total capacity of Wells 1323 and 1326 was 125 gpm at the time as compared with 300 gpm each for 3700 and 4241. Thus the mixture to be treated would be mainly water from the last two wells plus city water.

Well 3929 water was not to be used but its inclusion was necessary in all considerations because of (1) possible failure of other wells (2) radical change in water composition.

Table I indicated much of the silica and all the aluminum could be removed from well waters and city water by removal of suspended material. If base-exchange softening was to be considered this suspended matter had to be removed if only to prevent fouling exchange materials. With hot-process pretreatment silica removal might be satisfactory. But the high pH, hot

TABLE I: ANALYSES OF WELL WATERS IN PARTS PER MILLION

	1935, ppm								
Well No	747	748	750	1323	1324	1325	1326	1468	1469
Capacity, gpm	200(1)	120	300	170	173	250	95	100	170
pH value	5.9	5.4	5.9	4.1	4.5	4.9	4.0	5.1	4.6
Bicarbonate (HCO_3)	4	6	4	2	2	2	0	4	2
Sulphate (SO_4)	4	14	7	43	24	7	65	1	4
Chloride (Cl)	5	16	7	87	60	32	173	2	4
Silica (SiO_2)	9	7	8	9	6	9	10	7	7
Iron (Fe)	2	0.5	1	6	3	0.5	8	0.2	2
Aluminum (Al)	0	Tr	0	Tr	Tr	Tr	Tr	Tr	0
Manganese (Mn)	0	Tr	0	0.1	Tr	0	0.3	0	0
Calcium (Ca)	2	6	3	8	6	4	15	0.7	0.2
Magnesium (Mg)	1	4	2	6	5	2	12	0.7	0.1
Sodium (Na) Calc.	2	4	3	57	36	15	103	2	5
Total Dissolved Solids(2)	26	55	33	216	140	71	385	15	22
Suspended Material	2	0	2	Tr	0	Tr	3	Tr	Tr

	October 20, 1944, ppm					
Well No	1323	1326	3700	3929(4)	4241(3)	City
Cap, gpm	50	75	300	300	300	...
pH value	5.8	5.5	5.4	4.0	5.5	8.4
CO_3	0	0	0	0	0	10
HCO_3	6	4	4	2	4	47
SO_4	28	22	5	135	27	28
Cl	22	12	13	35	Tr	9
SiO_2(5)	12	10	39	10	6	5
SiO_2(6)	8	8	6	9	3	4
Fe(6)	1.1	0.2	0.5	0.9	0.1	0.3
Al(5)	2	1	2	2	1	2
Al(6)	0	0	0	0.2	0	0
Ca(6)	4	3	4	27	3	18
Mg(6)	1	1	1	0.5	0.5	2
$CaCO_3$(6)	14	12	14	70	9	55
Tot D S(9)	91	63	38	264	46	113
Sus Mat	10–12(7)	2–4(7)	74(8)	6–8(7)	2–4(7)	15–20(7)

(1) Estimated
(2) Sum of the components as determined by an analysis
(3) Drilled 25 ft away from old well No 1468
(4) Not used in boilers
(5) Total in water under test
(6) Filtered, total after filtration
(7) Estimated for water under test
(8) X-ray examination of suspended material. Calcite, quartz and aluminum silicate as sillimanite ($Al_2O_3.SiO_2$)
(9) Sum of components determined by analysis

water in the hot process would dissolve aluminum silicate and carry aluminum to the boilers.

Thus the most important step in preparation of makeup water was removal of suspended material by coagulation, preferably with a ferric-iron salt, followed by filtration at normal water temperature and at a pH of no more than 7 or 8 as an absolute maximum.

Following clarification, we considered three procedures, (1) base exchange (2) hot-process treatment with phosphate (3) 2-stage hot-process treatment for silica removal and phosphate softening.

Objections to the base-exchange system were as follows:

(1) It did not fit well into the water system. Before reaching the boiler house, make-up water passes through heat-exchange equipment in plant process. Here it attains a temperature 160 to 170 F. This meant base-exchange softening would have to occur before the makeup water was used for cooling.

(2) Further changes in well-water composition might mean use of more city water or poorer quality water such as that from Well 3929 (Table I). This development would pose two problems: need for increase in base-exchange capacity; possible need for hydrogen-cycle exchangers in addition to sodium cycle for adjustment of alkalinity if city-water consumption increased.

(3) There would be no provision for silica removal. While additional removal beyond clarification might not be necessary, the specter of changing well-water composition dictated otherwise.

(4) Good wells were being pumped as heavily as possible. Any increase in water use at the power plant meant greater consumption of city water. Thus the considerable quantity of water needed for rinsing base-exchange units was objectionable.

Single-stage hot-process phosphate softening would reduce treated-water hardness to a low point and minimize amount of sludge developed in boiler water. But should silica removal prove necessary, this system of softening would provide therefor. Further, if makeup water changes made preliminary hot, lime-soda softening desirable, the system would not be suitable.

The most logical system considered was 2-stage hot-process treatment. The first-stage hot-process unit would give some silica removal; the second stage, softening with phosphate. Should well water go bad and more city water or harder well water be needed, preliminary lime-and-soda-ash softening could be accomplished in the first stage and additional phosphate softening in the second.

The equipment selected is complete and provides for any eventuality except intolerable increases in concentrations of ions—sulphate and chloride.

Equipment Installed. Clarifying equipment, Fig. 2, includes a 40,000 gal tank where well water collects and mixes with enough city water to meet plant demands. This mixture is pumped through a meter and control valve to the 63,000-gph clarifier, where it is flocculated for removal of suspended material. Positive-displacement pumps feed ferric chloride and caustic soda, the flocculating agents, from separated dissolving tanks to the clarifier. Ferric chloride is automatically proportioned to the flow of water to the clarifier, and caustic-soda feed is controlled by pH value of clarifier effluent.

From the launders of the clarifier flocculated and settled water flows to a clearwell of 4000-gal effective capacity. From here it is pumped through eight 8-ft dia, vertical, pressure filters operating in parallel. Filtering material is Anthrafilt.

Filters are backwashed with filtered water and the backwash returns to the inlet section of the clarifier. No pumps are used; the pressure in the filter-effluent line serves to force water at a controlled rate of flow through the filter beds.

Filtered water goes to heat-exchange equipment in plant process. From there it returns to a 40,000-gal tank at the boiler house at 160 to 170 F. Cold, clarified, filtered water under control of a float-operated valve maintains a constant level in the tank.

From this tank filtered water is pumped through a meter, an air-actuated pilot-operated inlet-water controller and a vent condenser to the spray-type heater on the 63,000-gph first-stage hot-process unit, Fig. 3. The plant employs thoroughfare deaeration. Steam vented from the deaerating heater heats makeup water to 220 F in the first-stage hot-process spray heater. Noncondensable gases vent from the vent condenser.

Silica removal, for present-day water, constitutes the prime function of this first-stage hot-process unit. Caustic-soda solution and dolomitic-lime slurry used in the treatment are mixed in separate chemical tanks. They are then pumped into the sedimentation tank in proportion to the flow of water. Recirculation of sludge helps sedimentation and silica removal.

TABLE II: TREATED-WATER CONDITIONS CLARIFIER-FILTER EFFLUENT, 1947

Date	pH value	Hardness $CaCO_3$, ppm	Silica SiO_2, ppm	Iron Fe, ppm	Aluminum Al, ppm	Turbidity ppm
12/5	7.4	29	8	Neg	Neg	Neg

	First-Stage Hot-Process					Second-Stage Hot-Process						
Date	A(1) reading, ml	MO(2) reading, ml	Hardness $CaCO_3$, ppm	Silica Si_2O, ppm	pH value	A(1) reading, ml	MO(2) reading, ml	Hardness $CaCO_3$, ppm	Phosphate PO_4, ppm	Silica SiO_2, ppm	Chloride Cl, ppm	pH value
12/1.....	—	—	—	—	—	1.6	3.6	9	16	3	17	10.0
12/2.....	1.6	3.2	20	2	10.2	1.5	3.6	7	10	2	20	10.2
12/3.....	1.0	2.4	20	3	9.6	1.0	2.6	7	3	4	23	9.6
12/4.....	1.1	3.1	20	4	9.7	1.1	3.4	7	6	3	17	9.6
12/5.....	0.8	2.6	26	4	9.3	0.9	3.0	5	6	4	14	9.3

(1) Ml N/30 acid per 100 ml sample, phenolphthalein indicator. (2) Ml N/30 acid per 100 ml sample, methyl-orange indicator.

Settled water from the uptake cone of the silica-removal unit passes to the 63,000-gph second-stage hot-process unit for further treatment with anhydrous disodium phosphate. This unit operates flooded. Disodium phosphate solution is pumped from a dissolving tank to the sedimentation tank, in proportion to water flow. Phosphate-treated water flows from the uptake cone of the phosphate softener filters mentioned above.

Two 600-gpm pumps and rate-of-flow controllers handle filter backwashing with softened, filtered water. Backwash returns to the top of the phosphate softener.

Condensate returns to a collection tank at a rate of about 8000 lb per hr. From there it is pumped to the condensate compartment of the deaerating heater. Plans are progressing for recovery of about 35,000 lb per hr of plant condensate.

The thoroughfare deaerator is designed to heat 720,000 lb per hr of feedwater to a minimum of 220 F with 10-psig steam. Oxygen concentration of effluent is less than 0.03 ml per liter to the Winkler test.

Operating Results. Only one major operating difficulty has developed. Water quality has not been affected seriously but the operators have had to be extra vigilant.

The clarifier-filter installation where aluminum- and silica-rich suspended matter is removed from the well-city water mixture is the heart of the treating system. Floc formation has been good with as little ferric chloride as 8 to 8.5 ppm, but normally 15 to 20 ppm; enough caustic soda to hold pH close to 7 is needed.

At flow rates approaching the capacity of the equipment the slurry level has been too high and then additional load has resulted in carryover of an excessive amount of floc to clearwell and filters. This has happened particularly in the morning during filter backwashing and chemical-tank filling. The alert action of the operators has staved off trouble and kept the filters from being seriously fouled. They have been bypassing raw water into the clarifier launders, which reduces flow through the equipment and gives the slurry level a chance to drop. In spite of this bypassing procedure filtered-quality has not suffered because filter effluent contains negligible amounts of iron, aluminum and suspended material.

Laboratory tests indicate that weighting ferric-hydroxide floc with a few ppm of activated silica or bentonic clay materially increases settling rate. It is believed this procedure may solve the difficulty described above.

Silica removal and some softening with hydrated dolomitic lime and caustic soda at a pH close to 10.0 takes place in the first-stage hot-process softener. Chemical consumption varies because of irregularities in composition of well-city water mixture. Recent figures over a 15-day period are approximately 40-ppm dolomitic lime and 40-ppm caustic soda. Since silica concentration of clarified, filtered water is not high, removal is limited to a few ppm. It is arbitrarily based on holding concentration in boiler water to about 30 to 40 ppm with blowdown between 5 and 10% of makeup.

Anhydrous disodium phosphate at a pH in the neighborhood of 10 gives final hardness removal in the second-stage hot-process softener. Phosphate consumption changes with variations in hardness and suspended material present in the first-stage effluent. For a time it ran about 40 ppm, but the recent 15-day period averaged high, almost 55 ppm.

Hardness of the phosphate-softener effluent runs higher than expected, normally between 5 and 10 ppm as calcium carbonate. While efforts will be continued to reduce hardness as well as phosphate consumption the condition is not alarming. Sludge content of the boiler water is not high or troublesome.

Table II shows typical water conditions for a week in Dec 1947. Turbidity, and iron and aluminum concentrations of the clarifier-filter effluent were negligible. Hardness as calcium carbonate was 29 ppm; silica concentration, 8 ppm.

Hardness of the first-stage effluent ran about one-third lower than that of the clarifier discharge. Silica concentration was reduced 50% or more even though pH value dropped as low as 9.3 toward the end of the week.

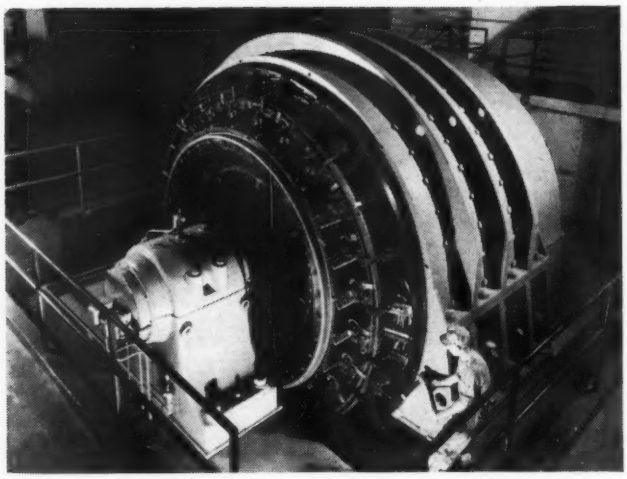
Silica concentration did not change in the second-stage effluent. Hardness was normal, between 5 and 10 ppm but, strangely, it was higher during the first part of the week when phosphate concentration and pH were higher. Explanation is not readily apparent since filtered, second-stage effluent is normally free of suspended sludge.

A word about chemical costs. Some variation can be expected. During the first 15 days of 1948 chemical costs per million lb of treated water amounted to $5.70. This is 4.8¢ per 1000 gal.

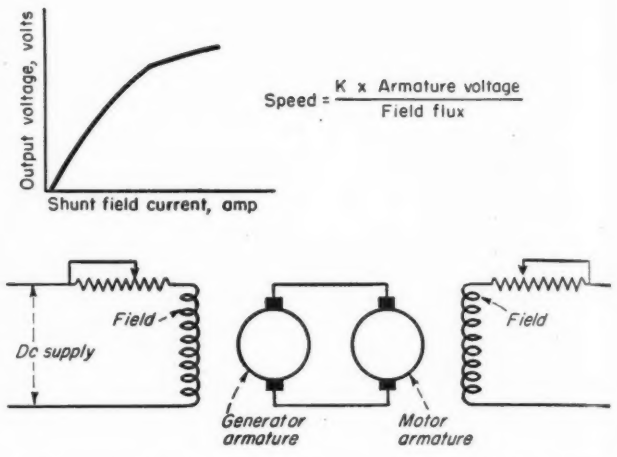
Boiler Results. The new 240,000-lb-per-hr steam generator has been on the line steadily since Feb 1947 and, by Feb 1948, has generated 1,512,729,000 lb of steam at an average rating of 230,000 lb per hr, peak rating 300,000 lb per hr.

There have been no tube losses or development of analcite scale in the older 125,000-lb-per-hr boilers. Occasional inspections have shown nothing but a little watery sludge.

Using the internal condition of the older boilers as an index of conditions in the new unit is a unique feature—particularly so in view of past experience with the older boilers and the fact that heat release per cu ft of furnace volume is considerably greater therein than in the new boiler.



1 Equipped with Ward-Leonard speed control, this 7000-hp dc motor, at 40-rpm base speed, reverses to 40 rpm in two sec



2 Generator feeds armature of controlled motor. Motor speed changed by varying armature voltage with generator field

Ward-Leonard System Assures Exact

Dc shunt motors, using Ward-Leonard speed-control system, suit drives which call for wide speed variation or the maintenance of exact speed, regardless of load changes

By **HENRY OMAN**
Engineer, Allis-Chalmers Mfg. Co. Milwaukee, Wis.

► SQUIRREL-CAGE INDUCTION motors are adequate for most industrial drives. They are simple, relatively inexpensive and reliable. However, there are some applications that require exactly constant speed under conditions of variable load. Other drives require an unusually wide range of speed. For these, and other special applications where exact control is needed, the Ward-Leonard system, although 57 years old, is hard to beat.

The basic patent, issued to the late Harry Ward Leonard on November 24, 1891, covered speed variation of a dc motor by changing its armature voltage. Variable armature voltage was obtained by varying the field of an intermediate generator. Since that time many patents have been issued covering modifications and refinements.

How It Works. Output voltage of a dc generator is produced by rotating armature conductors through lines of flux created by stationary field poles. Amount of voltage depends on rate at which these lines of flux are cut. By simply adjusting rheostat in generator shunt-field circuit, it is possible to increase or decrease current in the field, and hence the flux. Thus, output voltage of the d-c generator can be varied, as shown in Fig. 2, by simply adjusting field rheostat.

A dc motor has a speed characteristic described approximately by the formula:

$$\text{Speed} = \frac{K \times \text{Armature Voltage}}{\text{Field Flux}}$$

K, the constant, depends upon electrical design of the motor. Field flux can be varied by adjusting the motor field current with a rheostat. If field current is held constant, then motor speed varies directly with armature voltage. If armature voltage is held constant, speed varies approximately inversely with field current.

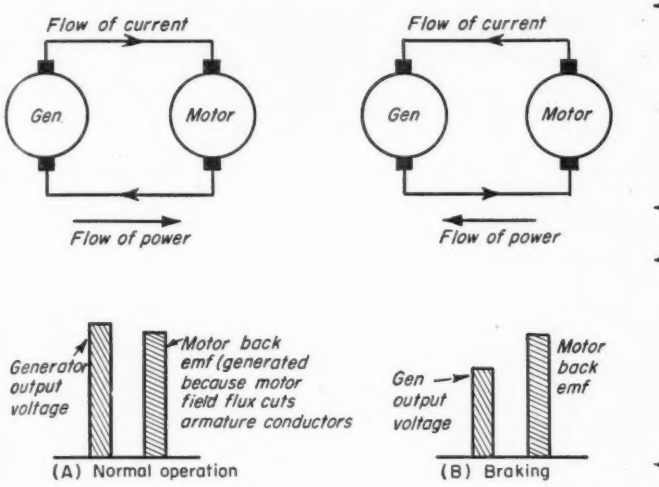
Obviously, it isn't desirable to reduce field current of a motor to zero with armature voltage on the machine, since speed would tend to approach infinity. It is interesting to note that speed in an ideal machine is not influenced by load torque, although torque does have a slight effect on the speed of a practical dc motor. However a motor can be designed so variation in speed caused by load fluctuations is small.

The Ward-Leonard speed-control system is made by simply connecting generator to motor as in Fig. 2. Motor speed can be adjusted either by varying generator or motor field. A properly designed motor will stay close to its set speed under all load conditions. Additional controls can be incorporated in generator field circuit to keep motor speed within a value which does not vary from its set speed by more than 0.1 percent of the motors rated top speed. Generator of a Ward-Leonard system is usually driven by a synchronous or induction motor, or by a prime mover such as a diesel engine or steam turbine.

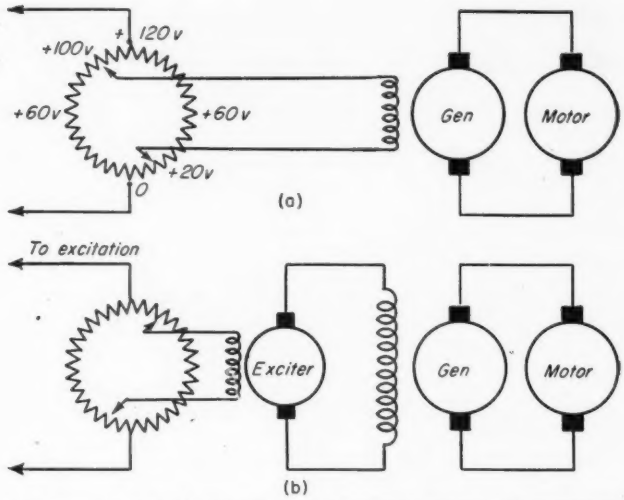
Reversing Service. With the Ward-Leonard speed-control system, it is just as easy to reverse a machine as it is to change speed. From the equation for the speed of a dc motor, Fig. 2, it is apparent that if armature voltage is negative, the speed of the motor will become negative (reverse).

A potentiometer type of field control permits reversing generator field, Fig. 4a. In the position shown, potentiometer contacts place +80 volts on generator field. If contacts are rotated counterclockwise to the horizontal position, no voltage is impressed on generator field, and hence no current flows. Further counterclockwise rotation of potentiometer contacts impresses negative voltage on generator field. Generator output voltage then reverses, and motor starts going backwards.

This reversing feature is especially



3 Regenerative braking or pump back occurs when generator voltage drops and connected motor has load with high WR^2



4 Generator field control for reversing motor. If generator is large, variable voltage exciter is used for field supply

Speed Control For DC Motors

useful in large blooming mills where the steel ingot is sent through the rolls several times to reduce it to a long bloom. It is especially suitable for diesel-electric marine propulsion drives where it is necessary to reverse the propeller to stop or maneuver the vessel.

Sometimes, when generators and motors are large, variable-voltage exciters are used in field circuit, Fig. 4b. The controlling rheostat or potentiometer can then be relatively small, and there is no need for power-consuming resistors in main generator or main motor field circuits. The Ward-Leonard system operates just as effectively with exciters in the field circuits as it would with a constant-voltage supply and rheostats in the field circuit. Furthermore, the exciter can have special fields which permit precise control of speed, torque or power.

Regenerative Braking. Another important feature of Ward-Leonard system is its regenerative-braking or pump-back ability.

Normal operation of the drive is shown in Fig. 3a where generator voltage is slightly higher than the back electromotive force of motor. This back emf, measured in volts, is result of motor armature conductors cutting lines of force generated by motor field. Product of armature current and back emf in the motor represents electrical power actually converted into mechanical power.

Difference between generator terminal voltage and motor back emf represents voltage required for forcing the load current through motor armature circuit. This drop within armature is normally quite low, about six to ten volts for a 240-v motor.

Now suppose generator voltage is suddenly reduced by changing generator field rheostat setting. If motor is connected to a mechanical load having high inertia, it will not slow down instantly. Consequently, motor back emf will remain at a high value until motor and its connected load slow down. If motor back emf is higher than terminal voltage of generator, then current will flow in the reverse direction, and flow of power will be from motor to generator.

As a result, the motor will absorb mechanical power from its load and pour it back into the generator. Generator will then try to speed up its prime mover; and when an alternating current motor is used to drive generator, it will actually put power back into line. This process is known as regenerative braking.

Flywheel Mg Sets. Sometimes load of a Ward-Leonard drive is intermittent and there are frequent regeneration impulses. A typical example is a reversing metal-rolling mill, where periodically inertia of rolls has to be absorbed by motor, and then supplied again when rolls start turning the other way. On top of that, a peak in power requirement occurs every time an ingot or bloom hits the rolls.

For this type of application, a flywheel is often installed on the supplying motor-generator set which is usually driven by a wound-rotor induction motor. When a regenerative impulse occurs, flywheel is speeded up slightly by generator. When a sudden load peak occurs, flywheel slows down slightly. Hence power requirement for the drive is smoothed out.

Often automatic slip regulators are installed in secondary of wound-rotor induction motor which drives generator. If input current to wound-rotor motor becomes high, the slip regulator adds resistance to rotor circuit, causing motor to slow down slightly. This permits flywheel to give up energy to dc generator. When input current to wound-rotor motor drops off, the slip control reduces secondary resistance permitting motor to catch up in speed by putting energy into flywheel.

Economic Limitations. Ward-Leonard drives are expensive because (1) dc machines are more expensive than ac; (2) it takes three machines to drive one load viz, an ac motor, dc generator and a dc motor. Certainly if a wound-rotor motor or a mechanical speed-changer can do the job more economically, it should be used. Keep in mind physical limitations of equipment itself as well as control type required.

However, there are many drives which call for precise control, a wide variation in speed, or exact speed regardless of load. For these drives, the Ward-Leonard system is suitable.

SPEAKING OF POWER

Note to power engineers: Don't build that new plant too close to an airport. A new law gives the Civil Aeronautics Administration broad powers, including condemnation authority, to prevent any construction near airfields which it considers a hazard to flying safety. At this writing, Braddock Light & Power Co is bumping against this new angle. For the new 160,000-kw generating station under construction at Alexandria, Va., plans call for 193-ft stacks. CAA says they would produce an "obstruction to air navigation" at Washington's National Airport more than a mile and a half away, wants them cut down to 162 ft. City officials of Alexandria, which has a comprehensive anti-smoke ordinance, say stacks that low would violate the ordinance, cause smoke and soot to pour over the city. All of which leaves Braddock right in the middle.

★ ★ ★

Generating facilities of the U. S. must be increased 80% in the next ten years, says Tomlinson Fort, manager of central station sales for Westinghouse. He forecasts a rise in electric power sold from 217 billion kwhr in 1947 to 374 billion in 1957. Basing his figures on Westinghouse planning studies, Fort credits heavy industry with 80 billion of the increase, points to potential gains in domestic, rural and commercial loads as well. Keeping pace with such growth would require that power companies spend in ten years an amount of money equivalent to the total now invested in all U. S. privately owned utilities.

★ ★ ★

Back from a 10,000-mile editorial trip which took him, entirely by air, from Seattle down the Coast to San Diego, then on to Mexico City and back through Texas and Oklahoma, Associate Editor Ben Skrotzki says that nowhere did he find power in ample supply, everywhere he found tremendous efforts being made to build for today's demands and the much bigger loads that most engineers expect for the future. In Portland at the time of the flood, he noted a wry sort of compensation—although flood waters drastically reduced output of key hydro plants, the same waters took many industrial plants off the line temporarily and there was no shortage of power for those in a position to use it.

★ ★ ★

R S Clark's verse about the fiendish propensities of the checker (Speaking of Power, May) drew the following rhymed rebuttal from I E Herman of Melbourne, Australia:

The Checker's life, some people say,
Is sheer delight in ev'ry way.
His work is easy and so free
No sweat, no toil, just zestful glee.
But let's be fair and free from pride
Come on, look from the other side.

Any drawing fresh from its completion
Looks rather nice, above suspicion.
Layouts seem right, lettering's fine
Figures in row, arrows in line.
Thus it's thrown in the Checker's lap
"Here's your baby—let's hear you yap!"

From under all the outward glamor
Like sore thumb sticks out the error.
His pencil scars the drawing's beauty
He can't help it, that's his duty.
Marking all mistakes with horror,
The print soon goes Technicolor.

When that is done, then comes the test:
To face the Spirit of Protest.
Faults, though tactfully presented,
More than likely are resented.
The Checker's ways can't be the same,
He has to stand it, that's the game.

To err is human, so they say;
Some are too human in that way.
Though he knows miracles don't exist,
The Checker stays an optimist.
He hopes that some day he will meet
A lovely, perfect, faultless sheet,
And find a man (if that's not too much)
Who admits his faults and bears no grudge.

★ ★ ★

Industry and government have joined forces informally in a coordinated program of exploratory drilling and assay work in the Western Colorado shale-oil fields. At least 11 core-drill holes will be sunk this year in the Green River formation—said to be the world's largest single mineral deposit. Four or more holes are planned by Union Oil Co of Calif. and seven by the Bureau of Mines acting for the Navy. In addition, Pacific Oil Co, a Standard Oil of Calif. subsidiary, is carrying on geological and assay work. All core drilling and other exploration by private companies will be carried out on properties they hold in the area. Government-sponsored drilling will be on Naval Shale Oil Reservation No. 1.

Keep an eye on this development—it has interesting possibilities. In discussion of synthetic fuels, shale oil has received relatively little attention. Although difficult to refine into some products, it makes a good burner fuel. Indications are that it can be produced and piped to the West Coast at not too high a cost. With an increasingly tight fuel situation there, shale oil may be first substitute fuel to achieve acceptance.

★ ★ ★

Enthusiasts of the old iron horse wiped a quiet tear one day this summer when the last steam locomotive left the Schenectady shops of American Locomotive Co, now to be devoted 100% to manufacture of diesel-electrics. Steam railroaders took some comfort from the fact that a good share of Alco's steam-locomotive facilities will be "mothballed" to meet any future demands.

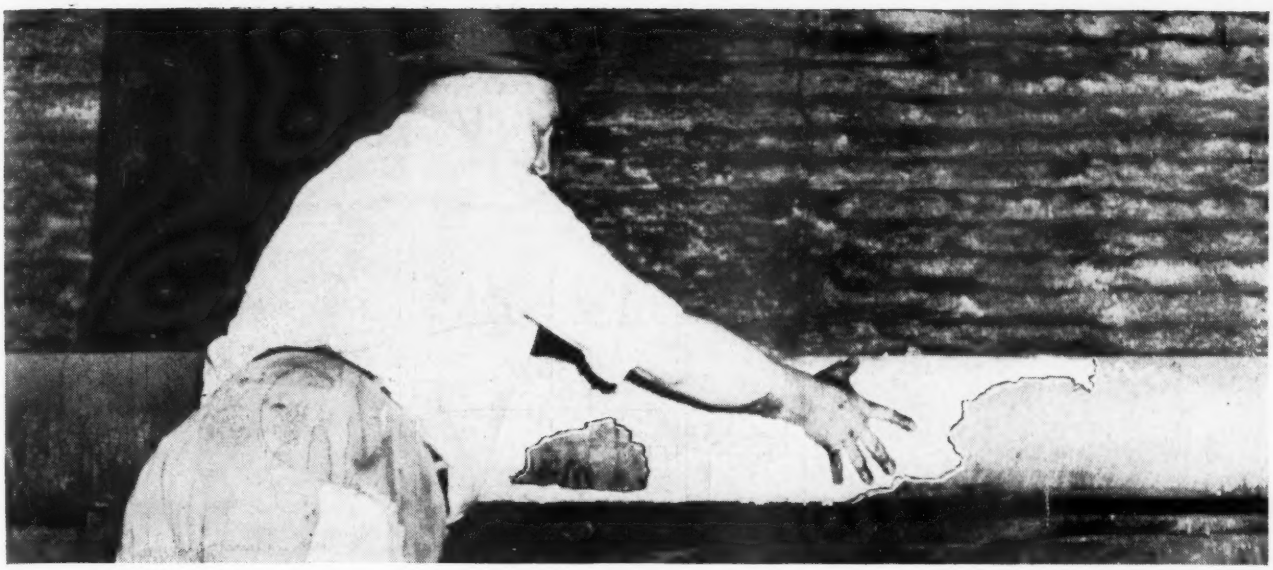
★ ★ ★

A Houdry-process gas turbine, once destined for lend-lease to Russia and obtained from WAA by Bureau of Mines, has been made available to BCR's Locomotive Development Committee for experimentation with pulverized fuel at the Dunkirk plant of American Locomotive Co. A similar smaller unit will be used in the second underground coal gasification experiment at Gorgas, Ala.

THIS MONTH'S COVER

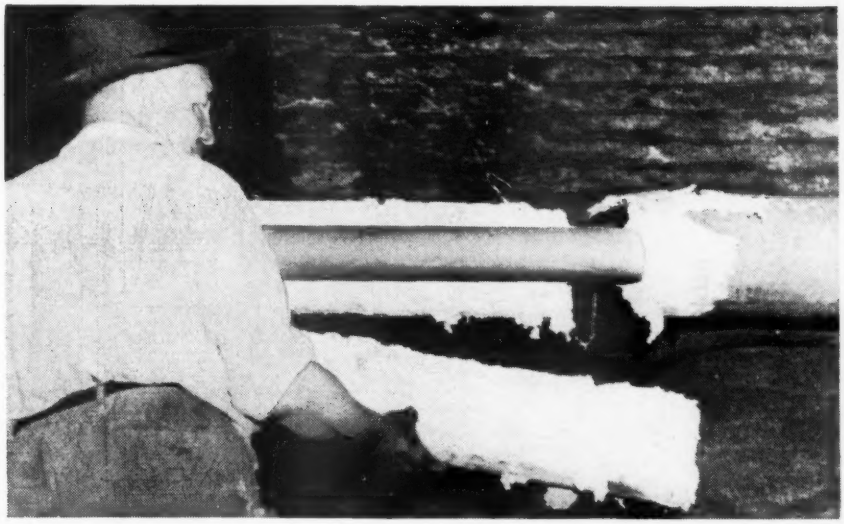
Keeping the kilowatts coming is the job of maintenance crews in power plants all over the country. There's no glamor in it—looked at in cold blood, it's a matter of hard work, often done at odd hours and under trying conditions. But no plant—large or small, new or old—is any better than its maintenance, and like all necessary jobs, this one has its real satisfactions.

This month's cover—wrought-iron tubes going into the air heater of a central-station boiler—typifies the job and the men who do it.



1 Stripping off canvas jacket, covering 2-in.-thick sections of 85% magnesia insulation applied to a piping insulation at Waterside generating station of Consolidated Edison 46 years ago, showed that insulation sections were hard and firm

Insulation Holds up 46 Years



2 Insulation pieces taken from pipeline operating at 450 F, Fig. 1 above, under laboratory tests for conductivity, indicated little or no loss in this factor

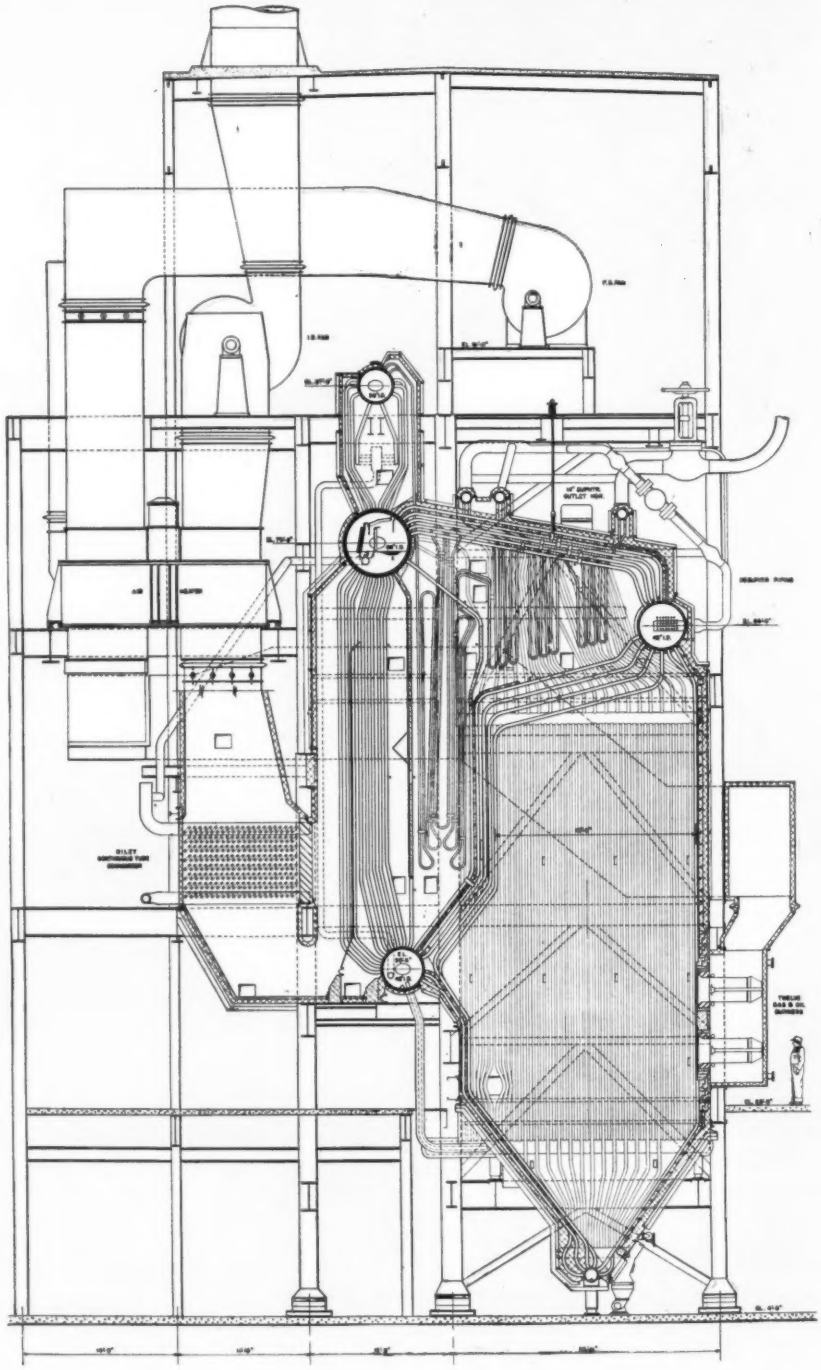
▶ WATERSIDE STATION of Consolidated Edison Co, New York has a heavy modernization program under way. In the course of this program magnesia insulation first applied 46 years ago had to be pulled off older equipment, slated to be scrapped.

Upon removal of the canvas jacket, insulation surface, Fig. 1, 2, and 3, showed hard and firm. Sections removed could be handled easily and gave little apparent indication of dimensional change in blocks from shrinkage or warping over the years.

Pipe insulation, Fig. 1 and 3, 2 in. thick, served on pipelines operating at 450 F 24 hr a day, 365 days a year, for 46 yr. Sections were laboratory-tested to determine thermal conductivity of the samples. They tested 0.52 at 300 F mean temperature. This is in agreement with the known fact that conductivity of the product at the beginning of the century ran somewhat higher than today's 0.45 conductivity average.

3 Blocks of 85% magnesia, cut from standard sizes and applied to gridded surface of feedwater heater 46 years ago, show no apparent shrinkage or warpage

The Regularity with which Riley Use



Another RILEY Repeat Order

City of Los Angeles, Calif.
3 orders — 5 Riley Units
3,825,000 lbs./hr. capacity

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Washington Buffalo Cleveland Detroit Chicago St. Louis Cincinnati St. Paul
Pittsburgh Kansas City Denver Seattle Portland Los Angeles Houston New Orleans Atlanta Memphis Tulsa

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS

Users Repeat with more Riley Units

tells a significant story to purchasers of steam generating units

Riley Boiler users have, with gratifying regularity, repeated for more Riley Units when installing additional steam generating units. The accompanying tabulation lists but a few of the companies which have repeatedly placed orders for Riley Units. This preference, this refusal to accept something almost as good, by Riley users, tells a significant story of the satisfactory performance of Riley Steam Generating Units.

Users know well the operating advantages of Riley Units — their ability to operate at high capacity over long periods of time, their high sustained efficiency, their negligible maintenance and trouble-free operation. Operating advantages resulting from the many distinctive design characteristics and good engineering of Riley Units.

The large number of repeat orders representing more than half of all Riley business, together with the great swing to Riley by companies installing Riley units for the first time, have boosted Riley sales to the highest in Riley history. Users have learned they can rely on Riley.

These well-known companies and many, many others have repeatedly ordered Riley boiler units

HOUSTON LIGHTING & POWER CO.
8 orders—9 Riley Units
4,590,000 lbs./hr. capacity

CELANESE CORP. OF AMERICA
12 orders—23 Riley Units
2,615,000 lbs./hr. capacity

CARNEGIE-ILLINOIS STEEL CO.
5 orders—10 Riley Units
2,370,000 lbs./hr. capacity

STANDARD OIL CO. OF CALIF.
12 orders—20 Riley Units
1,885,000 lbs./hr. capacity

CENTRAL ILLINOIS LIGHT CO.
5 orders—5 Riley Units
1,400,000 lbs./hr. capacity

CARBIDE AND CARBON CHEMICAL CO.
9 orders—17 Riley Units
2,310,000 lbs./hr. capacity

DOW CHEMICAL CO.
7 orders—13 Riley Units
3,030,000 lbs./hr. capacity

CITY OF LOS ANGELES, CALIF.
3 orders—5 Riley Units
3,825,000 lbs./hr. capacity

UNION ELECTRIC CO.
3 orders—7 Riley Units
2,240,000 lbs./hr. capacity

COMMONWEALTH & SOUTHERN CORP.
(SOUTHERN DIVISION)
6 orders—6 Riley Units
1,380,000 lbs./hr. capacity

HUMBLE OIL & REFINING CO.
4 orders—8 Riley Units
1,600,000 lbs./hr. capacity

MASONITE CORPORATION
6 orders—7 Riley Units
415,000 lbs./hr. capacity

SWIFT & CO.
5 orders—6 Riley Units
455,000 lbs./hr. capacity

SCOVILL MANUFACTURING CO.
4 orders—4 Riley Units
455,000 lbs./hr. capacity

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

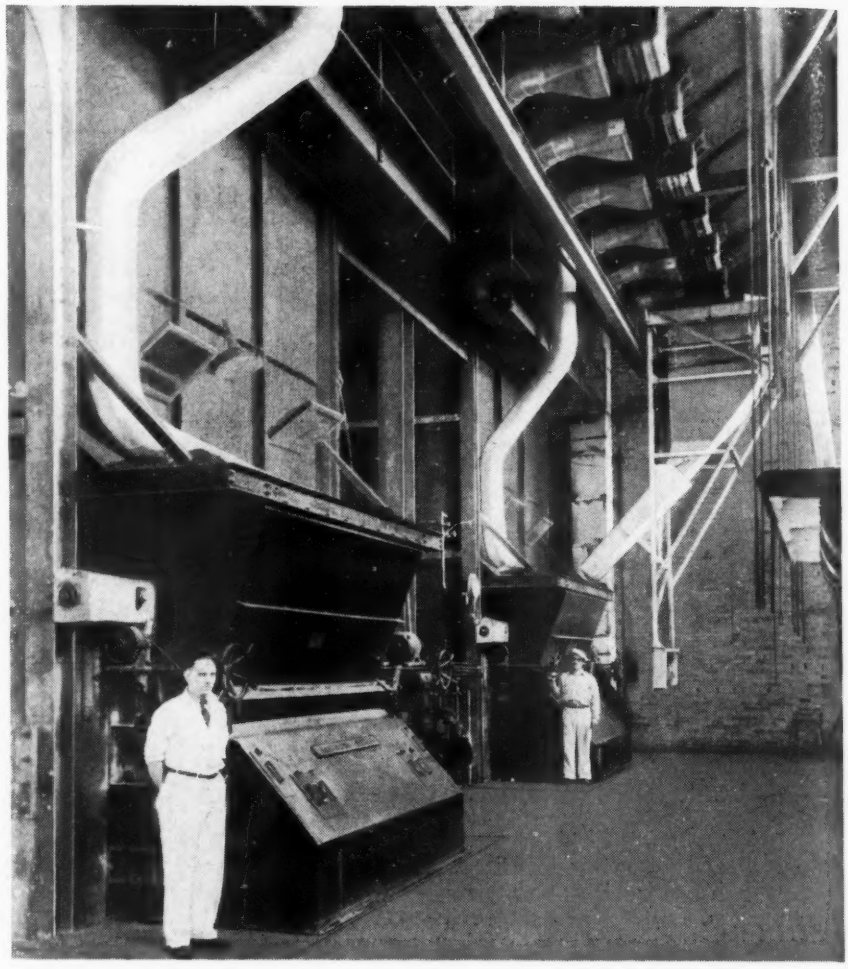
. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

Burns Bug-Dust Lignite

Expanded plant with chain-grate stokers burns lignite having 35% moisture and only 7000 Btu. Monthly boiler and furnace efficiency is 76%. Furnaces have special water-cooled arches and use overfire air from nine horizontal nozzles above the front arch

By G E GIBSON, Chief Engineer
Canada Packers, Ltd
St. Boniface, Manitoba



COAL DUST IS ELIMINATED from the boiler room by an exhaust duct along bunker's bottom with intakes to each coal gate and along each stoker hopper. That's why operators wear white suits even though fine, dusty coal is distributed by a weigh larry

▶ MEAT PACKING, like many other industries, expanded greatly during the war. The millions leading strenuous lives in the armed forces and in labor's ranks needed more and more body-building food. Moreover, canned and dehydrated meats and new packing-house byproducts were developed along with an enormous and growing output of fats for glycerin and soap. As every plant was pushed to maximum production, requirements of steam, power, air and refrigeration also increased.

Canada Packers' St. Boniface plant, one of the largest packing houses in western Canada, soon faced serious problems because power-house equipment could not meet growing demands. During the lean 1930's one 6000-kw electric-steam generator met practically all requirements. This unit was originally installed to use off-peak power, available at low rates. Two venerable B&W straight-tube boilers, in semi-retirement after nearly 50 years, were used only during the busy fall season.

New Steam Generator. By 1940 it was obvious this equipment would not meet demands, so plans were made to add to the steam-generating capacity. In 1941 a new generator, rated 36,000 lb per hr, 130 psi, saturated, was installed in an extension to the boiler room. Surveys showed that the cheapest fuel available was Souris bug-dust, a lignite averaging 7½% ash, 33 to 35% moisture, 7000 Btu per lb. This high-moisture fuel is burned on a traveling-grate stoker. Furnace construction is conventional with a long ignition arch and refractory walls.

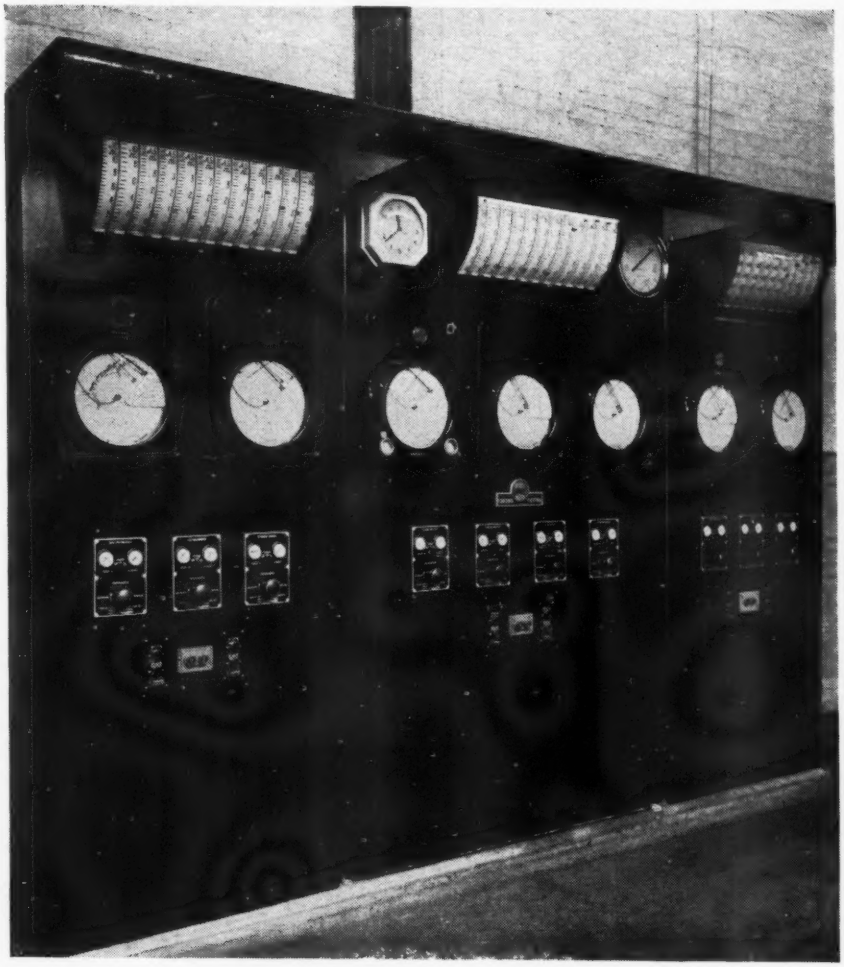
This generator has forced- and induced-draft fans, economizer, air heater, automatic combustion control. A new 160-ft cast-concrete stack was erected, large enough to take care of expansion that was foreseen even then.

This unit gave excellent service, often at severe overloads, as expansion taxed boiler capacity to the utmost. Meanwhile, rapid expansion in the twin cities of Winnipeg and St. Boniface added a problem. The electric utility no longer had excess power at peak periods, and warned that the electric-steam generator could operate during off-peaks only.

Two Additional Units. Early in 1946 we surveyed steam requirement. Peak load had reached 98,000 lb per hour with averages of 70,000 in the busy season. We therefore decided to scrap the two old straight-tube boilers and install two units of about the size of the new boiler. Duplicates were considered, but experience suggested certain improvements. Refractory maintenance costs had been high under the heavy loads carried. Also, the long pipelines through the expanding plant made superheat advisable. Accordingly, we requested the designers to incorporate waterwalls, watercooled arches and superheaters in the new units.

The designers, in turn, proposed a new furnace to provide rear-arch firing for lignite and a more open furnace throat. This design was developed for greater fuel versatility so other coals than lignite could be burned, if there should be delays in coal fields and transportation.

Demolition of the old boilers started March 1, 1946. The old boiler room was extended and its roof raised to conform to the newer section. Erection of the new boilers started the first week in



METERS AND CONTROL. Each boiler has automatic combustion control, and all three controls are tied into a master regulator which coordinates the operation of all boilers. Meters guide operators in maintaining high boiler performance at all times

At Efficiencies to 79%

May. The first unit was ready for trials by Sept 3.

Trial Runs. First trial runs, while satisfactory in many respects, revealed some flaws in gas circulation. Gases stratified in the furnace and shot straight up to the first pass, bypassing the rear furnace tube bank. Flyash carryover, always a problem with lignite bug dust, was excessive. After making tests and studies of gas circulation we applied a blast or blanket of overfire air through a row of nozzles above the front arch.

Air at static pressure of about 11 in. wg is supplied by a high-head fan through a duct, and introduced into the furnace by nine nozzles between the front-wall tubes. This air sweeps the flame toward back of furnace above the rear arch, causing increased turbulence and a longer flame travel. This equipment increases boiler and furnace efficiency nearly 5%.

At the same time, flyash carryover was greatly reduced. Finally, automatic combustion control of the overfire air, correlating air volume to the boiler load, was worked out and applied.

As far as I know, this is the first application of overfire air jets to this type installation. The highly satisfactory results exceeded expectations.

In rear-arch firing, as now practiced in these furnaces, main air supply from the forced-draft fans enters the furnace well toward the grate's rear. Main flame, deflected forward by the long rear arch, crosses the furnace from back to front at an angle and strikes the bull-nosed front arch. Radiant heat from this flame dries and ignites incoming fuel. Deflected by the front arch and the blast of air above it, the flame passes back across the furnace again, toward the rear-tube bank, where a baffle turns it forward and upward once more to the first pass. Thus gas travel forms a rough "Z," giving plenty of room for thorough gas mixture and complete combustion.

A test run on a bituminous coal of totally different characteristics from lignite showed this furnace will burn it with fairly good results if necessary.

Each new boiler consists of an upper drum 54 in. dia x 10 ft long, a 36-in. mud drum 11 ft long, with 198—2½-in. and 121—3¼-in. steam-generating tubes, giving a total heating surface of 5072 sq ft including waterwalls. Water is supplied to sidewalls and front-arch tubes by 7½-in. square headers. Rear arch is cooled by extending the front two rows of rear tubes forward and downward around the arch, then back to a rear waterwall header on top of back wall.

Furnace has a volume of 1680 cu ft, and coal is burned on a traveling-grate stoker with 140 sq ft effective grate area.

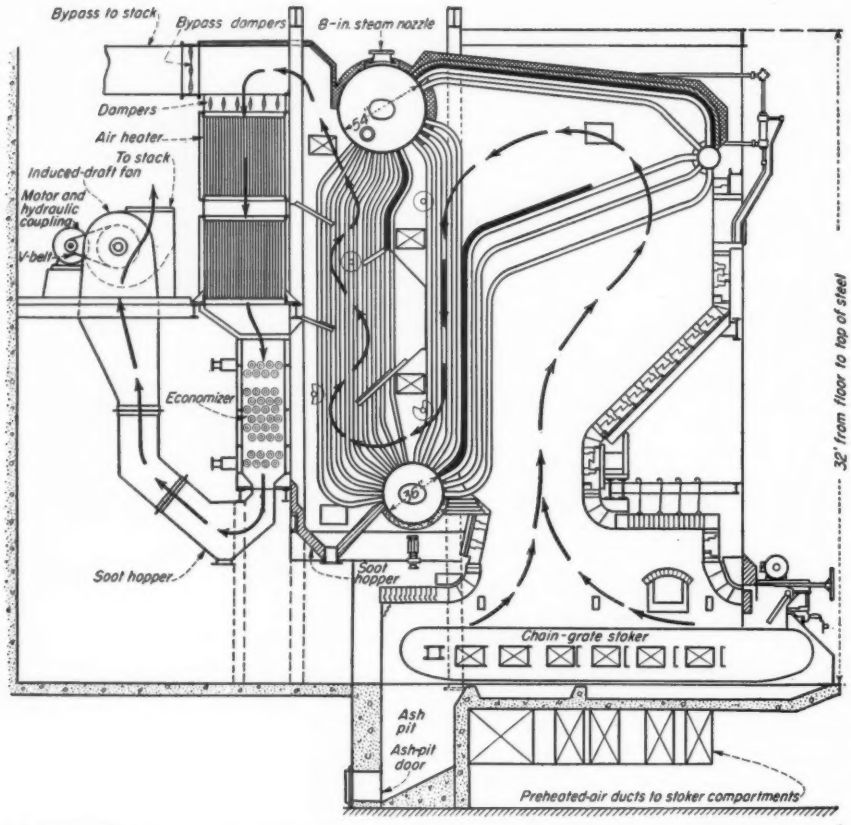
Automatic combustion control regulates forced- and induced-draft dampers and stoker speed. Meters record steam pressure, feed temperature, gas temperature in each boiler, economizer and air-heater outlet, and air-temperature as well as steamflow airflow relationship for each unit.

An integrator on each boiler records steam production. Twelve-point draft gages show draft pressure at the air-heater outlet, stoker-wind-boxes, furnace-uptake, economizer, and air pressure in and out of air heater. Pushbutton controls for induced- and forced-draft fan and stoker motors are mounted on the meter panel.

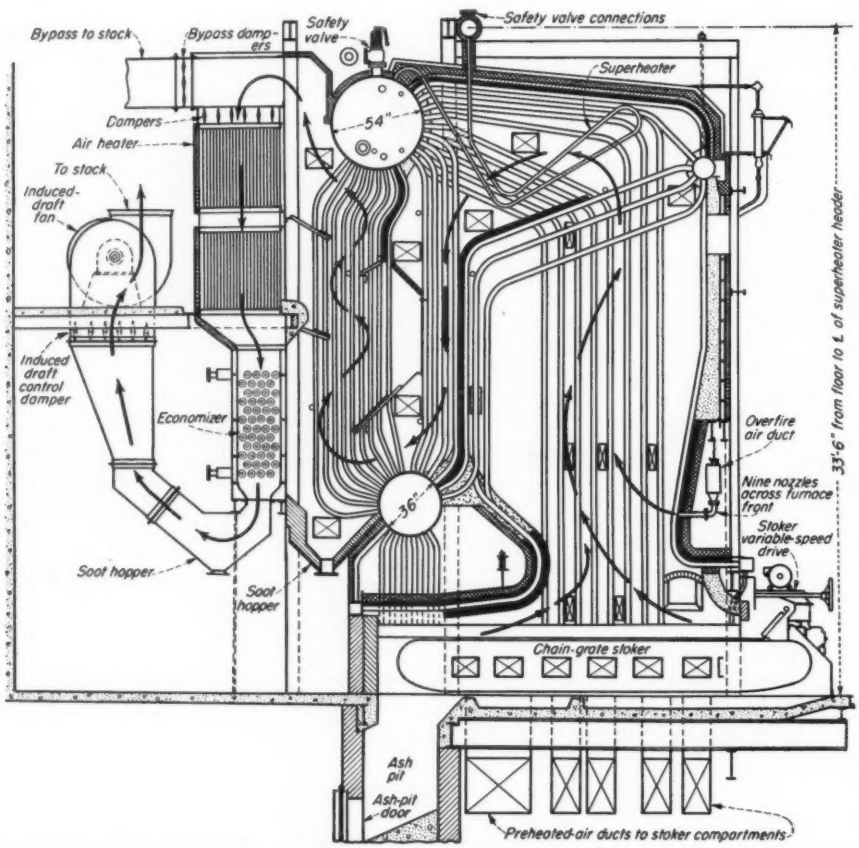
Modern Equipment. All boiler-room equipment is as modern as possible with emphasis on dependability, maintenance of service and flexibility to meet widely varying demands without sacrifice in efficiency.

Coal is received in gondola cars on a spur track in front of the boiler room. Dumped directly into either of two grated track hoppers, it is elevated by continuous-flow conveyors into overhead bunkers running the length of the room in front of the boilers. These bunkers hold 220 tons, enough for 48-hr operation under heavy demand. An electrically driven 2-ton weigh larry takes coal from any bunker gate and delivers it to any of the three boilers.

Ashes fall from rear of traveling



BOILER NO. 1 was installed first. It has an economizer, air heater and forced- and induced-draft fans. The unit is fired with lignite on a traveling grate stoker. The furnace is equipped with a long ignition arch and refractory walls



BOILERS NO. 2 AND 3 have furnaces with a more open throat than No. 1. Furnaces are designed for rear-arch firing to burn coals other than lignite if this should become necessary. Nine nozzles between the front-wall tubes supply overfire air

grate into an ashpit with a steeply sloped floor and run by gravity to the ashpit doors that open into the basement. When the doors open, a few strokes with a hoe pull the ashes out into a hopper. From there, they are blown through a vacuum conveyor to a cyclone collector set on steel legs at one side of the power house. Ashes drop directly from collector into a dump truck to be hauled away.

A steam venturi tube discharging into a dust washer provides the vacuum for the ash-handling system. Fine dust, which escapes from the cyclone collector, is washed out by water sprays. Branches from the ash conveyor to each boiler front remove ash droppings that accumulate at front of traveling grates. A line also extends to the foot of the stack to handle flyash.

To eliminate coal dust, an exhaust duct runs the length of the boiler-room ceiling with intakes beside every bunker gate and along the top of each coal hopper (photo page 98). A powerful exhaust fan is connected with mercoid tilt switches on the arm of each bunker gate and on the lever operating the weigh-larry gate. Opening any coal gate starts the fan automatically, setting up a strong draft over the coal being discharged and sucking any fine airborne dust into the exhaust system. This fan discharges to the atmosphere above the boiler-room roof. A vacuum cleaner encourages good housekeeping.

For ventilation, an 11,000-cfm fan draws fresh air from outside and discharges it through a distributing duct into the basement. This air passes upward through stairwells and other openings into the boiler room, and, as it becomes warmer, rises to the ceiling where it enters the intakes of the forced-draft fans. Air at intakes of these fans averages 80 F in winter and 100 F in summer, adding a little to efficiency as well as helping to make the working levels more comfortable.

Feed-water System. Two closed deaerating heaters supply feed at 200 F to the centrifugal feed pumps. Three units are driven by steam turbines and one by a 3500-rpm electric motor.

Condensate returns from packing-house processing equipment are often contaminated with animal fats. Accordingly, these returns are collected in a vacuum-return system and pumped through a diatomaceous earth filter before entering the feedwater heater.

Firemen check boiler-water concentrations twice each shift with a test kit, and feedwater treatment supplied by continuous chemical feeders is regulated accordingly. Each boiler is fitted

with a continuous surface blowdown system, whose setting the firemen regulate manually in accordance with boiler-water conditions. Induced-draft fans are powered both with electric motors and steam turbines. The turbines are connected to the fan shaft through automatic over-running clutches.

Steam-generating plant now has a capacity, including the electric-steam generator, of 148,000 lb per hr, coupled with a high degree of flexibility which permits efficient operation at any load. The electric-steam generator is operated on off-peak power only, but is useful, notably on summer weekends when steam demand is low, or when quick steam increase is required.

Duplication of practically all equipment has greatly facilitated maintenance work, and resulted in a marked reduction in weekend and overtime repairs.

A large measure of dependability and flexibility has been obtained without sacrifice in efficiency. The new units on 8-hr trial runs developed efficiencies as high as 79%. The whole coal-burning plant over a 28-day period with widely fluctuating loads has shown over-all efficiencies of 75% and 76%. These percentages, a little better than expected, are excellent for this high-moisture refuse coal.

Efficiencies and costs are worked out daily in the chief engineer's office and all charts checked to make sure firemen are using all aids to the best possible advantage. Some retraining was necessary, as the new units need a slightly different firing technique for best results. The firemen have real interest in developing the new ideas in these units, and have a growing enthusiasm for them.

PRINCIPAL STEAM AND ELECTRICAL EQUIPMENT

Steam Plant of Canada Packers, Ltd

STEAM-GENERATING EQUIPMENT:

Electric steam generator.....Canadian General Electric Co, Ltd
One, 6000 kw, 4000 v, 60 cyl, 3 ph, 3 cast-iron electrodes, design pressure 250 psi, working pressure 130 psi saturated
Circulating pump.....Canadian Allis-Chalmers, Ltd
One, 500 gpm, 20-ft head, 680 rpm, centrifugal
Circulating-pump motor & starter....Canadian General Elec Co, Ltd
One, 30 hp, 550 v, 680 rpm, squirrel cage, line start
Feed pump.....Canadian Allis-Chalmers, Ltd
One, 100 gpm, 405-ft head, 3550 rpm
Feed-pump motor & starter.....Canadian General Elec Co, Ltd
One, 30 hp, 550 v, 3550 rpm, squirrel cage, line start
Steamflow recorder.....Bailey Meter Co, Ltd
Coal-fired boiler No. 1, economizer, air heater...Foster Wheeler, Ltd
One, 2 drum, bent tube, air cooled, steel-incased furnace; 4673 sq ft heating surface; *economizer* 1020 sq ft; *air heater* 2940 sq ft; rated continuous steaming capacity 36,000 lb per hr saturated; design press 160 psi, working press 130 psi; 1542 cu ft furnace volume, 30,000 Btu full-load heat release per hr per cu ft effective furnace volume 30,000 lb steam per hr
No. 2 and 3 boilers.....Foster Wheeler, Ltd
With economizers, air heaters, superheaters and waterwalls. 2 drum, bent-tube watercooled furnace and arches; steel incased; 5072 sq ft heating surface including waterwalls; *economizer* 1020 sq ft; *air heater* 2940 sq ft; rated continuous steaming capacity 45,000 lb per hr, design pressure 160 psi, operating pressure 130 psi at superheater outlet, 403 F total steam temperature; 1680 cu ft furnace volume; 34,800 Btu heat release per hr per cu ft of total furnace volume at 45,000 lb of steam per hr
Structural steel and breechings.....Dominion Bridge Co, Ltd
Boiler refractories.....Bigelow Liptak Corp
Boiler heat insulation.....Winnipeg Supply & Fuel Co
Soot blowers.....Diamond Power Specialty Corp
Chimney .....Custodis Canadian Chimney Co, Ltd
One, concrete, 9 ft inside dia, 160 ft high
Building construction and boiler settings..Winnipeg Supply & Fuel Co
Boiler-room ventilating fan.....Canadian Sirocco Co, Ltd
One, motor driven, 850 rpm, 11,000 cfm, 10 in. wg
Ventilating-fan motor & starter.....Canadian General Electric Co
One, 25 hp, 550 v, 850 rpm, squirrel cage, line start

COMBUSTION EQUIPMENT:

Automatic combustion control.....Bailey Meter Co, Ltd
Stokers, motor driven.....Foster Wheeler, Ltd
Harrington chain grate, 9x16 ft, 140 sq ft effective grate area
Stoker motors.....English Electric Co of Canada
3, 2 hp, 550 v, 1125 rpm, squirrel cage, line start
Stoker motor starters.....Canadian Controllers, Ltd
Stoker variable-speed drives.....Reeves Pulley Co
Forced-draft fans.....Canadian Sirocco Co, Ltd
One, motor driven, 17,000 cfm at 5½ in. wg and 165 F; 2, motor driven, 23,000 cfm, 6.04 wg at 80 F
F-d-fan motors.....English Electric Co of Canada, Ltd
One, 25 hp; 2, 30 hp, 550 v, squirrel cage, line start
F-d-fan motor starters.....Square D Co Canada, Ltd
Induced-draft fans.....Canadian Sirocco Co, Ltd
One, motor driven through hydraulic coupling, 27,000 cfm, 357 F, 6.0 in. wg; 2, motor & turbine driven, 35,000 cfm, 356 F, 5.02 wg
I-d-fan motors.....English Electric Co of Canada, Ltd
One, 30 hp; 2, 50 hp, 550 v, squirrel cage, line start
I-d-fan motor starters.....Square D Co Canada, Ltd
I-d fan turbines.....Coppus Engineering Corp
2, 45 hp, 3555 rpm, fitted with Coppus 4.11 to 1 reduction gear
I-d-fan hydraulic coupling.....Canadian Sirocco Co, Ltd
Turbine automatic clutches.....British Liquid Meter Co, Ltd
Overfire air fan.....Sheldons, Ltd
One, motor driven, 10,000 cfm, 11 in. wg
Overfire-air fan motor.....Commonwealth Electric Corp, Ltd
One, 15 hp, 550 v, 1200 rpm, squirrel cage, line start
Overfire-air-fan motor starter.....Canadian Cutler-Hammer, Ltd

COAL AND ASH-HANDLING EQUIPMENT:

Coal elevators and conveyors..Stephens Adamson Mfg Co of Canada
Continuous flow, 25 tons per hr
Coal bunker, suspended steel.....Dominion Bridge Co, Ltd
Coal gates on bunker.....Stephens Adamson Mfg Co of Canada
Coal weigh larry.....Canadian Fairbanks, Morse Co
Coal-dust collecting fan.....Robbins & Myers Co
Coal-dust fan motor.....Commonwealth Electric Corp, Ltd
One, 15 hp, 550 v, 1150 rpm, squirrel cage, line start
Coal-dust fan-motor automatic control.....Canadian Controllers, Ltd
Ash conveyors, pneumatic.....United Conveyor Corp
Cyclone ash collector.....United Conveyor Corp

VALVES, PIPING AND TRAPS:

Safety valves.....James Morrison Brass Mfg Co, Ltd
Nonreturn valves; h-p and l-p valves.....Crane, Ltd
Blowdown valves .....Yarnall-Waring Co
Electric-valve operators.....Minneapolis Honeywell Regulator Co
Pressure-reducing valves.....James Morrison Brass Mfg Co, Ltd
Pipe fabricator or contractor.....Standard Plumbing & Heating
Pipe insulation.....Western Asbestos Co, Ltd
Steam traps and strainers.....Yarnall-Waring Co

FEEDWATER SYSTEM:

Feed treatment, internal; chemical feeders..Aluminate Chemicals, Ltd
Water columns .....Reliance Gauge Column Co
Feedwater heaters.....Canadian Allis-Chalmers, Ltd
2, Cochrane, deaerating, 80,000 lb per hr, from 160 to 200 F
Continuous blowdown system.....Aluminate Chemicals, Ltd
Blowdown tank.....Manitoba Bridge and Iron Works
Feed pumps, 3 turbine-, 1 motor-driven..Canadian Allis-Chalmers, Ltd
2, 100 gpm, 405-ft head, 3500 rpm; 2, 200 gpm, 500-ft head, 3500 rpm
Feed-pump turbines.....Coppus Engineering Corp
One, 6 nozzles, 24 hp; 2, 10 nozzles, 48.6 hp, 3500 rpm
Feed-pump motor and starter.....Canadian General Electric Co
One, 30 hp, 550v, squirrel cage, line start
Turbine governors.....Fisher Governor Co
Feedwater regulators.....Bailey Meter Co
Condensate-return pumps.....Nash Engineering Co
2, motor driven, 100 gpm, 20-ft head, 1200 rpm
Condensate-ret-pump motors & starter....Canadian General Elec Co
2, 5 hp, 550 v, 1200 rpm, squirrel cage, line start
Condensate-return filter.....Infilco, Inc
Filtering medium, Cellite.....Canadian Johns-Manville Co, Ltd

METERS:

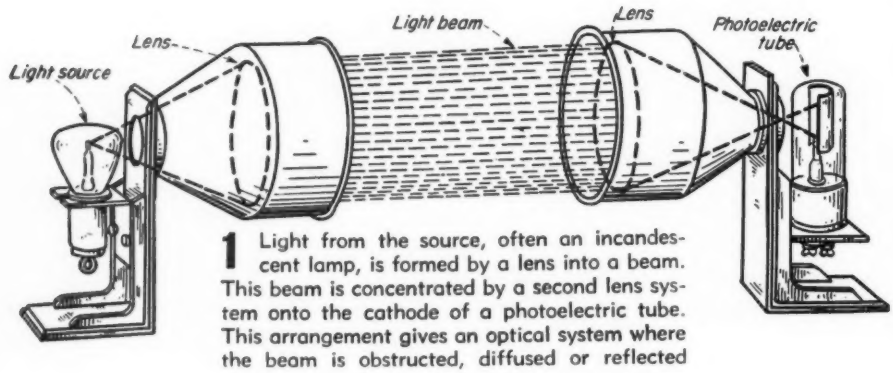
Boiler meter and control panels; steamflow-airflow meters, economizer and air-heater temperature recorders, steam-press & temp recorders, 9- and 12-point draft gages.....Bailey Meter Co, Ltd
Pressure gages.....Peacock Bros, Ltd
Thermometers, industrial..Taylor Instrument Companies of Canada, Ltd
Co_2 indicators and recorders.....Hays Corp

ELECTRONICS FOR THE POWER ENGINEER

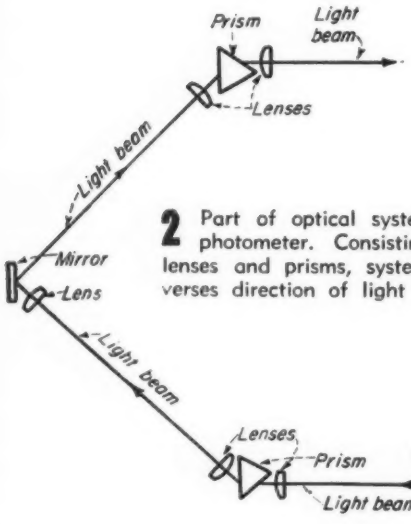
By F A ANNETT, *Associate Editor*

5—Photoelectric Tubes

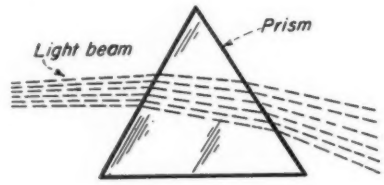
Optical Systems for Photoelectric Tubes



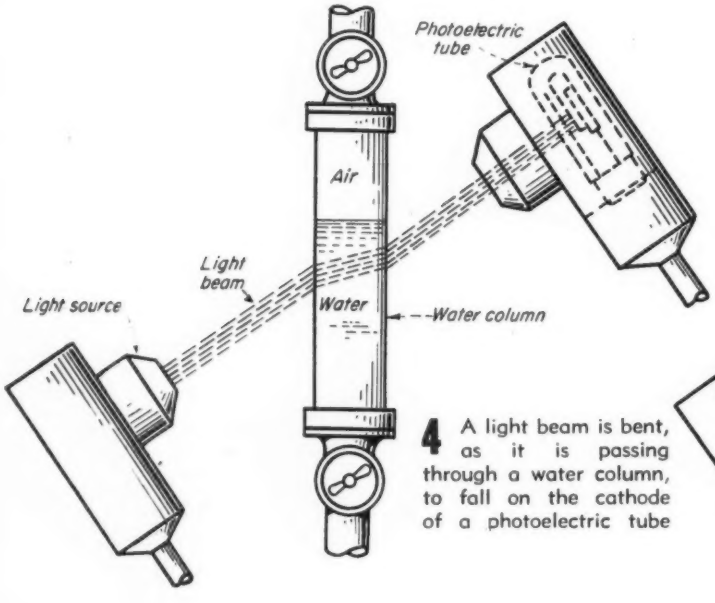
1 Light from the source, often an incandescent lamp, is formed by a lens into a beam. This beam is concentrated by a second lens system onto the cathode of a photoelectric tube. This arrangement gives an optical system where the beam is obstructed, diffused or reflected



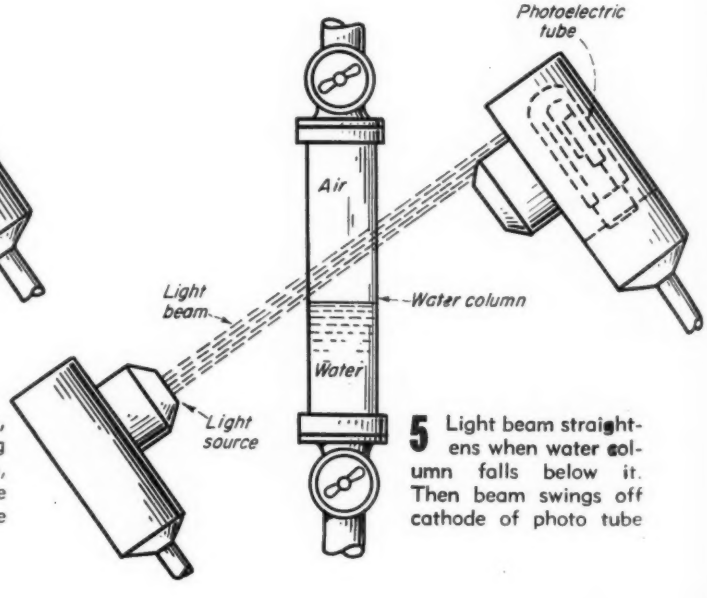
2 Part of optical system of photometer. Consisting of lenses and prisms, system reverses direction of light beam



3 A light beam that enters a prism from one side is bent toward the base while it is passing through the pyramid



4 A light beam is bent, as it is passing through a water column, to fall on the cathode of a photoelectric tube



5 Light beam straightens when water column falls below it. Then beam swings off cathode of photo tube

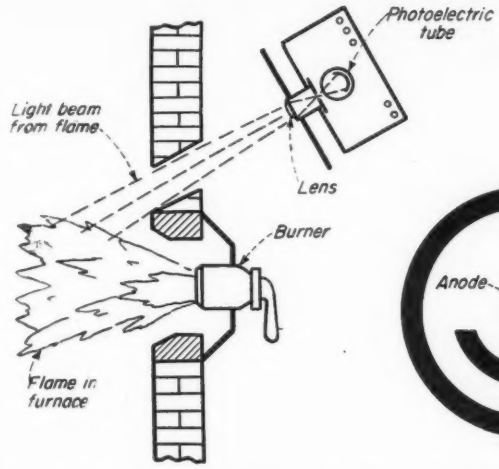
►PHOTOELECTRIC-TUBE CATHODES have comparatively small areas, usually 1/5 to 2 sq in. So even with intense illumination we have less than one lumen on the cathode. To concentrate maximum light flux on a cathode. some form of optical system is used.

For example, if the light in a room or an incandescent object actuates the tube, a single lens system, like that on the right, Fig. 1, concentrates this light. Same principle applies as when a magnifying glass concentrates the sun's rays to burn a hole in a piece of paper. But in our photoelectric-tube application, the light has only a small fraction of the intensity of the sun's rays.

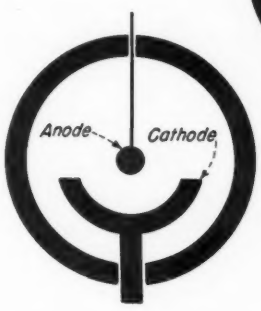
Often an incandescent lamp is the light source and is directed as a beam across a space onto the photoelectric tube's cathode. For these applications two lenses are used, Fig. 1. One at the light source forms a beam that is directed across space to a second lens that concentrates the beam onto the tube's cathode. This arrangement provides an effective optical system for many applications where the beam is obstructed, diffused, reflected, refracted or deflected.

Obstruction. As an example of obstruction, a light beam is thrown across an elevator's entrance. While a passenger, getting off or on the car, is in the beam, a relay remains open to break the door-closing circuit and the doors

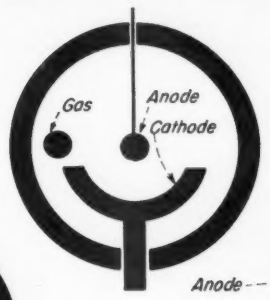
Photoelectric-Tube Symbols and Characteristic Curves



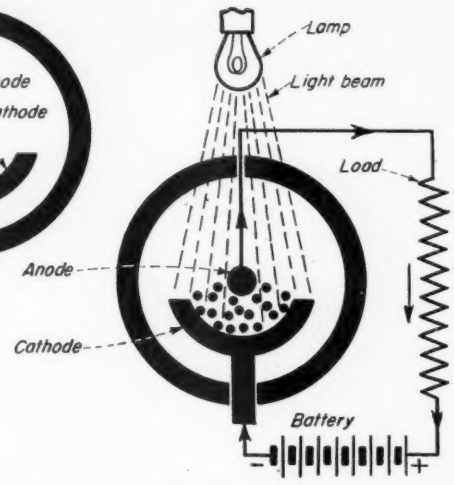
6 A photoelectric scanning system focuses the light from a flame through a lens on the cathode of the tube



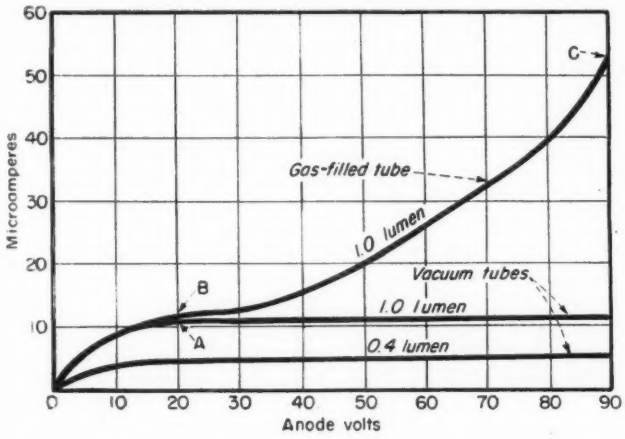
7 The symbol for a vacuum photoelectric tube with a curved coated-metal cathode and a vertical wire anode



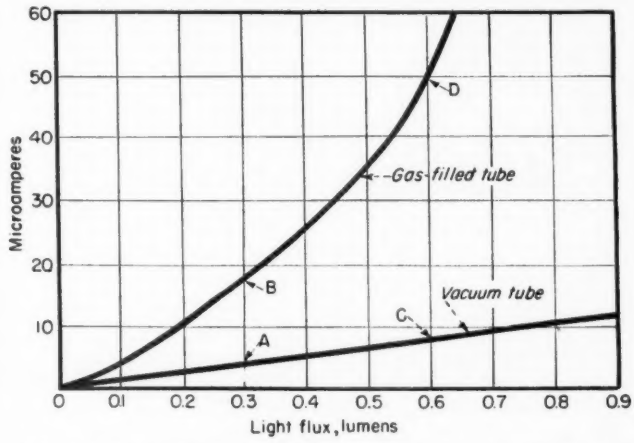
8 The symbol for photoelectric tube that is gas-filled. Dot indicates the gas as in a hot-cathode tube



9 Elementary-circuit diagram uses tube. Positive terminal connects to anode, and negative to the cathode



10 Relation between anode volts and current flow for a given light intensity in vacuum and gas-filled photo tubes



11 Relation between light flux in lumens and current flow for given voltage in vacuum and gas-filled photo tubes

cannot close as long as beam is broken.

In the reverse of this application, the light beam is directed across a door opening. When a person walks across the beam a relay closes to energize the opener to open the door. A timing relay holds it open a given period to let the person pass; then the relay functions to let it close.

In another application a factory truck, approaching an electric-elevator door, interrupts a light beam. This actuates a photo-electric relay that starts the elevator machine to bring the car to the floor when the doors open for the truck.

Objects on a conveyor are counted automatically as they move through a light beam. Obstructing this beam actuates a photoelectric relay that causes a counter to function.

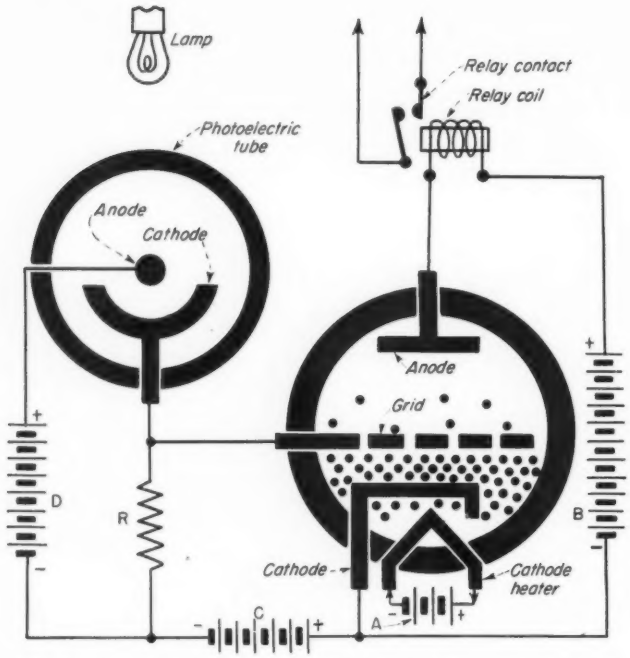
Diffusion. Applications where the light beam is diffused include smoke-density indicators. Here, as the density changes. the amount of light reaching the photoelectric tube also changes. This causes the smoke-density indicator to function accordingly, and generally to sound an alarm if a specified density is exceeded. A similar use is found in detecting turbidity in liquids.

Reflection. A mirror may reflect the light beam much as tilting a mirror makes a light beam race across a wall. Reflection is used to measure speed of fast-running shafts. A light beam reflected by a tiny mirror on the shaft's end acting through a photo-electric relay gives accurate speed indication.

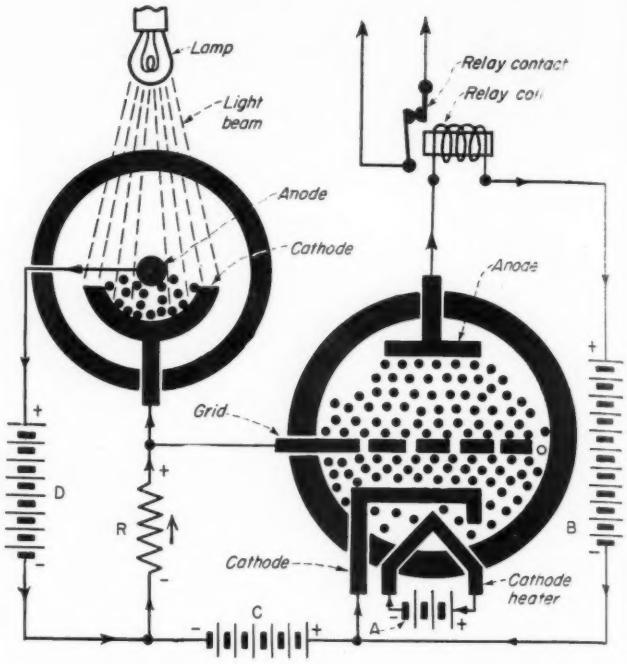
A photoelectric recorder is another reflection application. Weak input signals cause the movement of a tiny mirror. Reflected light from it controls a photoelectric-tube follow-up system that makes a permanent record of the weak electrical-input signal.

A prism provides another method of reflecting or bending a light beam toward a photoelectric tube. In its simplest form a prism is merely a glass pyramid. Light entering the pyramid from one side is bent toward the base as it passes through the glass, Fig. 3.

Deflection. Fig. 2, which diagrams part of the optical system of a photometer, gives a good illustration of how prisms and mirrors bend light beams in electronic metering devices. Light from the lamp is focused into a beam and directed to the left to a prism. Here the beam first passes through a lens and into the prism where it is deflected and passes through another lens toward a



12 Circuit diagram of photoelectric and hot-cathode tube, As long as light does not reach tube, no current flows



13 Circuit diagram of photoelectric and hot-cathode tube. When light beam falls on photo tube's cathode, current flows

mirror. The mirror reflects the beam toward another prism. When the beam leaves this prism it is going in a direction opposite to that when it left the lamp. Most optical systems are not so complicated, but this one shows that, by proper use of lenses, prisms and mirrors, a light beam can be deflected in any direction.

Refraction. Refraction bends the light beam. A good example is passage of a light beam through a water column, Fig. 4. Here water bends the beam to fall on the cathode of the photoelectric tube, which holds a relay open to prevent water flow into the boiler or other vessel.

When the water in the column drops below the light beam, Fig. 5, the beam straightens and goes above the tube's cathode. This condition permits the relay to close and open the valve in the water line or start the feed pump to restore the water levels.

Amount of light falling on a photoelectric tube's cathode is also varied in its intensity. One of these applications is a photoelectric relay turning on lights when natural lighting intensity goes below a fixed minimum and turns them off with the natural source above a predetermined level.

A photoelectric pyrometer is responsive to the radiant-heat energy from the material in a furnace or kiln. This heat can thus be made the means of regulating the temperature of the material or other related factors in the furnace.

Color changes in lights, another form of changing light intensity, also operate photoelectric systems. These are applied to control chemical processes in which color changes are critical.

Flame Intensity. Flame-failure safeguards may be considered as operating on flame intensity, even though the only time they are called upon to function is when the flame goes out. This is similar to obstructing the light to the photoelectric tube.

A photoelectric scanning system is set up so light from the flame is focused through a lens on the tube's cathode, Fig. 6. As long as the flame burns, photoelectric protective system holds the fuel valve open. If fuel supply to the burner fails the flame goes out. Then the photoelectric system permits the fuel valve to close and it will not open again until operated manually.

Photo-electric Tube Current. Consider some elementary circuits in which photo-electric tubes are used. Fig. 7 shows the symbol for a vacuum Fig. 8 the symbol for a gas-filled tube. The dot, Fig. 8, indicates gas as in hot-cathode tubes. As previously mentioned, filling the tube with gas at low pressure increases the current flow, particularly at elevated voltages, as shown by the curves in Fig. 10.

For example, with one lumen of light flux on cathode of the photoelectric tube and 20 v. applied to anode, current flow is about 11 microamperes, point *A*. With a gas-filled tube results are practically the same, point *B*. Increasing anode volts beyond 20 causes practically no increase in current flow in the vacuum tube. In the gas-filled tube, however, current increases rapidly until at 90 v it is 54 microamperes, point *C*.

A similar relation exists between light in lumens reaching the cathode and microampere flow through the tube. The curves, Fig. 11, show this relation for about 90 anode volts. With 0.3 lumen beamed to the cathode, current flow is about 4 microamperes in the vacuum tube, point *A*, and 18 microamperes in the gas-filled tube, point *B*. At 0.6 lumens, current flow is 8 microamperes for the vacuum tube, point *C*, and 49 microamperes in the gas-filled tube, point *D*.

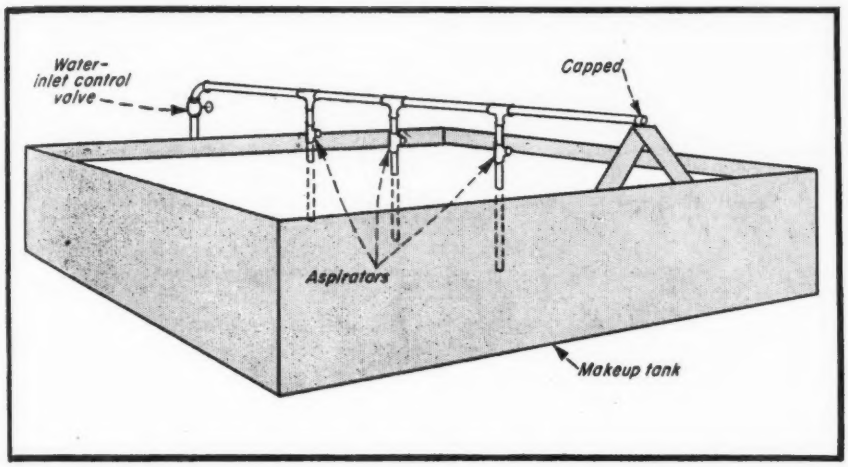
Current flow in the gas-filled photoelectric tube increases for the same reason as in the hot-cathode tube (July POWER, pp 108-112). Electrons emitted from the cathode collide with gas atoms and knock one or more electrons out of them. As a result, number of free electrons is greatly increased in the space between cathode and anode.

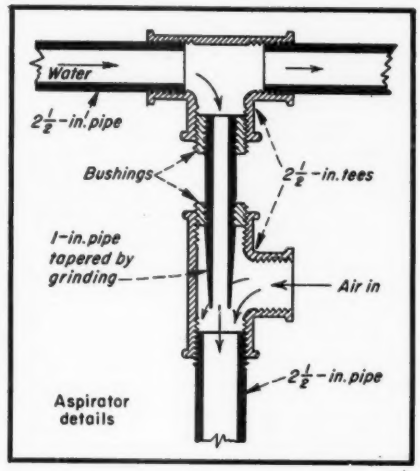
Atoms that lose one or more electrons become positively charged ions. These ions neutralize most of the negative space charge effect that exists in the high-vacuum tube, and permit more electrons to reach the anode. This action combined with a large increase in free electrons produces a large increase in current flow through the tube com-

(*Continued on page* 136)

POWER ENGINEERS' NOTEBOOK

PLANT-TESTED IDEAS TO SOLVE PROBLEMS OF DESIGN, OPERATION AND MAINTENANCE





SIMPLE ASPIRATORS REDUCE CO_2 IN MAKEUP WATER

BECAUSE OF the proximity of a paper plant using large quantities of chemicals a Southern utility plant found its surface-water supply contained about 70 to 80 ppm of CO_2. Several methods of reducing this concentration were tried with varying success. Spraying the incoming makeup water through a 3-in. pipe, drilled with 200 ⅛-in. holes, had little effect. Investigation of spray towers and troughs proved they were too costly.

Another method that was tested introduced compressed air into the water through a series of holes in a copper tube. Results were good, reducing CO_2 by 70%, but this setup required running the air compressors 24 hr a day.

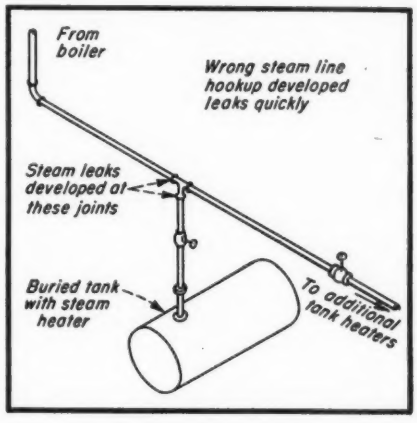
The present method was then devised, the design being based on a successful type of ejector chlorinator. Three ejectors or aspirators were built up of fittings and hooked up as shown in the above sketches. The makeup water flowing through the supply line enters the vertical 1-in. pipe. The stream leaving this short section of pipe aspirates air from the atmosphere through the open branch end of the tee.

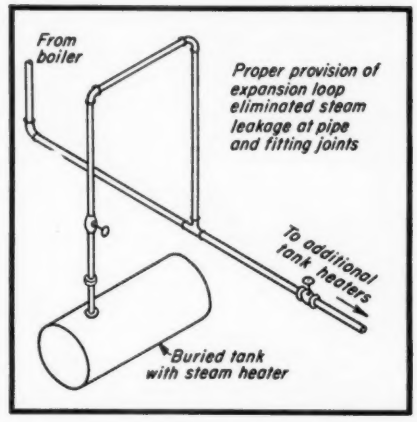
Tests have shown a reduction in CO_2 content of 50 to 60%. Further advantages of this system are (1) no attention required (2) no maintenance needs (3) zero operating cost. Mechanical agitation would be of added value.

DALTON WHITE *Atlanta, Ga.*

Proper Expansion Loop Eliminates Steam Leaks

OUR PLANT IS FITTED with a buried "day" oil tank and two 500,000-gal oil-storage tanks. To reduce oil viscosity, all three tanks are provided with oil heaters, supplied from a 1¼-in. steam line. The day tank had a direct and short connection to this steam line as shown, left. After the first few days of operation, the tee connection for the day tank developed pronounced steam leakage. The leaks were repaired, but it was only a matter of a few days before the same trouble arose again.

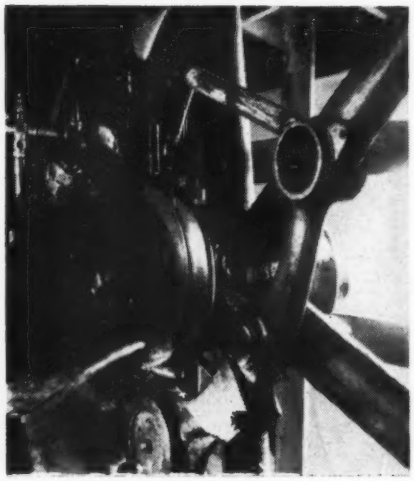

From boiler
Wrong steam line hookup developed leaks quickly
Steam leaks developed at these joints
Buried tank with steam heater
To additional tank heaters

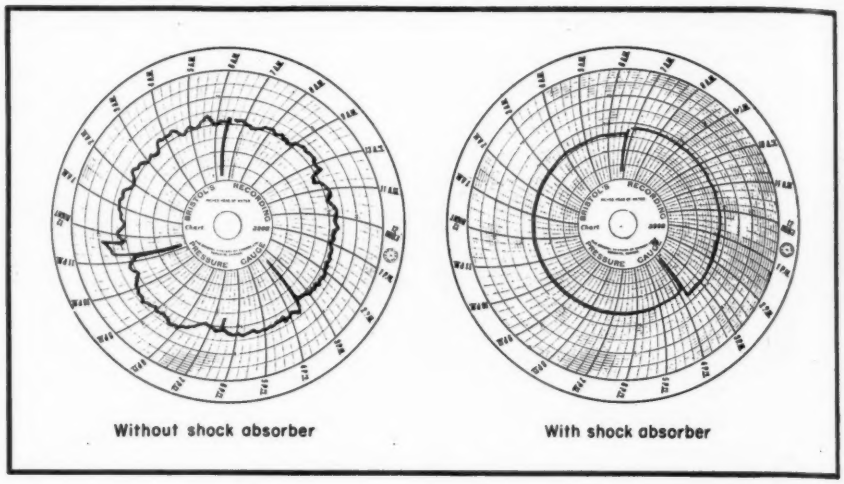

From boiler
Proper provision of expansion loop eliminated steam leakage at pipe and fitting joints
To additional tank heaters
Buried tank with steam heater

Since expansion of the steam-supply line caused the trouble, redesign of the tank connection must take proper account of this movement. This was accomplished by the rearrangement shown at right, which called for only a few extra lengths of pipe and two elbows. This loop has been operating for two years without trouble.

JOHN R BROWN *Bauta, Cuba*

(*Continued on page* 106)





SHOCK ABSORBER SMOOTHS GOVERNOR OPERATION

AN AUTOMATIC 14x14-in. reciprocating steam engine, with an inertia governor and single variable cutoff eccentric, drives a fan for mine ventilation through a 6-ply belt. At an engine speed of 138 rpm the governor could not be adjusted to function properly even though it had been completely overhauled with rebushing of bearings and renewal of shafts.

Insufficient tension on the eccentric support shaft allowed excessive governor arm motion, with each revolution causing the head end to do nearly all the work, and created excessive wear of governor parts. When the tension was increased it caused a wide variation in speed as indicated by the left-hand chart showing the fan pressure. This resulted from the insensitiveness of the governor to changes in boiler pressure varying from 90 to 140 psig.

This condition was remedied by connecting an automobile shock absorber between the counterweight end of the governor arm and the nearest flywheel spoke, as in the picture above. More oil had to be added to the shock absorber than originally supplied to effect proper governor action. The right-hand chart shows the resulting steady performance of the engine because of proper governor response. The engine has run for five months with the shock absorber without adjustments.

D J BRENTON *Drumheller, Alberta*

CARD FILE KEEPS TRACK OF EQUIPMENT MAINTENANCE

TO KEEP our maintenance schedule up-to-date we have devised a simple card-file system. Cards like the one shown here are made up for each individual maintenance job and marked with the number of week's interval between inspections. A file for each of the 52 weeks in a year is provided and the cards are placed in the file corresponding to the week during which the indicated work is to be done. In the sample card the last maintenance job was done the second week of March. Since the chore is to be done every 12 weeks the card will now be filed in the second week of June. During the second week in June all work in the file will be performed and the cards moved forward the correct number of weeks.

The maintenance card carries the date of performance, any special comments and the job order number. The job orders are issued every week to the maintenance mechanics from the file cards for that week. Upon completion of the work the mechanics turn in the job orders, duly filled in and signed. The maintenance clerk then enters these on the maintenance cards and moves them to their next file positions. All cards, of course, do not move ahead to the same file since the intervals vary.

The system has proved very satisfactory, all maintenance is done at the required time, a concise record is available of all work done, and the condition of the equipment is known at all times.

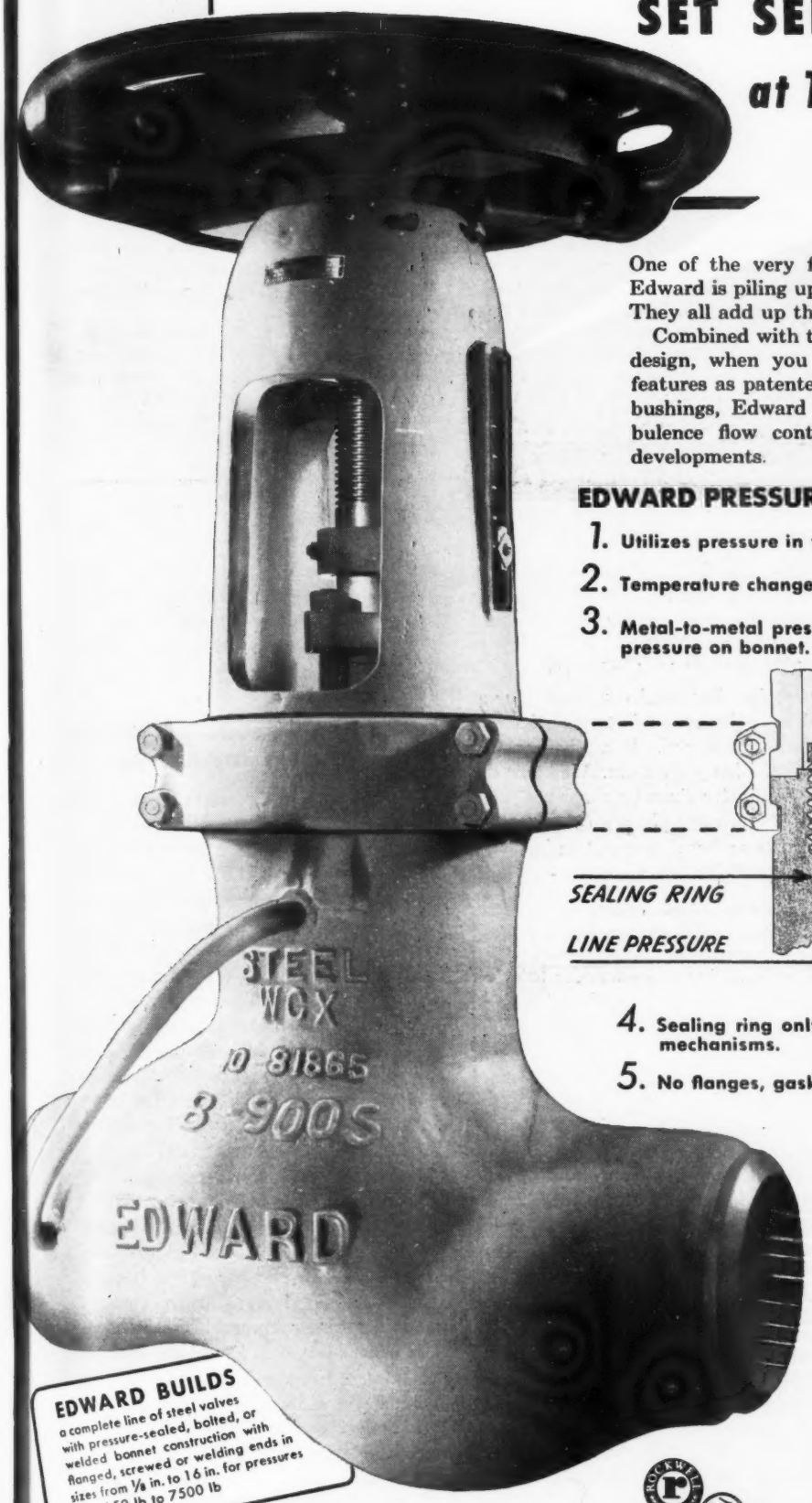
S MARTINEZ, JR *Bauta, Cuba*

THE BLANK TEXTILE COMPANY, INC.
Engineering Department
Maintenance Record

Equipment: Feedwater pump No. 3
Location: Power plant, 1st floor
Inspect eve 12 weeks

DATE			COMMENTS	Job Order No.
Week	Month	Year		
2	Dec	45	Inspected, Found ok	3418
2	Mar	46	Changed rebel ball bearing	3537
2	Jun	46	Inspected, Found ok	3665
2	Sep	46	Inspected, Found ok	3790
2	Dec	46	Repacked, 8 turns of 3/8"	3880
2	Mar	47	Inspected, Found ok	3005
2	Jun	47	Inspected, Found ok	3140
2	Sep	47	Inspected, Found ok	3280
2	Dec	47	Bearing housing cleaned, new oil	3350
2	Mar	48	Inspected, found ok	3475

Edward SELF-SEALING Bonnet Joints SET SERVICE RECORDS at TOP TEMPERATURES, PRESSURES

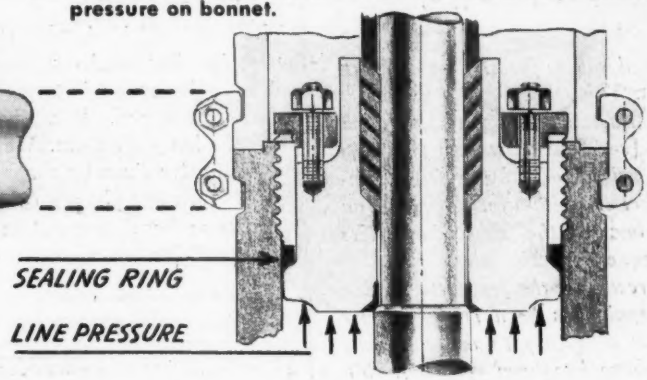


One of the very first builders of pressure seal bonnet valves, Edward is piling up experience reports from stations everywhere. They all add up the same—satisfaction.

Combined with the Edward experience on pressure seal bonnet design, when you specify Edward valves you get such extra features as patented Impactor handwheels and EValthrust yoke bushings, Edward Equalizer, closure indicators, controlled turbulence flow contouring, and many other exclusive Edward developments.

EDWARD PRESSURE SEAL BONNET JOINT FEATURES

1. **Utilizes pressure in valve to seal bonnet joint.**
2. **Temperature changes have no effect on bonnet joint tightness.**
3. **Metal-to-metal pressure on sealing ring always greater than line pressure on bonnet.**



4. **Sealing ring only seals—does not support yoke or closing mechanisms.**
5. **No flanges, gaskets or bolting to periodically re-stress.**
6. **Saves space—reduces weight.**
7. **Disassembly and reassembly, if ever required, greatly simplified and speeded up.**

EDWARD BUILDS
a complete line of steel valves with pressure-sealed, bolted, or welded bonnet construction with flanged, screwed or welding ends in sizes from 1/8 in. to 16 in. for pressures from 150 lb to 7500 lb

30% MORE FLOW
No valve series has ever been designed with more extensive flow research—on no other valves is there more proven flow data. See for yourself—send for Edward Bulletins 706 and 707.

Edward Valves, Inc.

SUBSIDIARY OF ROCKWELL MANUFACTURING CO EAST CHICAGO, INDIANA

PROBLEMS FROM THE PLANT

Exercise your engineering wits by submitting answers to this question, fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

HOW OFTEN SHOULD WE RESOCKET ELEVATOR ROPES?

WE HAVE BEEN discussing the question of how frequently we should resocket elevator ropes, but are unable to come to any agreement. There seems to be a wide difference of opinion on this subject even among the experts.

One concern, which manufactures and maintains drum elevator machines, resockets the car hoisting ropes each year on overhead machines, and every two years on basement machines. The Bureau of Standards circular, *Elevator Wire Rope Maintenance*, recommends resocketing all ropes each year on overhead machines, and every two years on basement type.

It has been our experience that, under normal operating conditions and with proper maintenance, these ropes seldom show signs of fatigue at the sockets during their life span.

We would certainly appreciate the opinion of POWER readers on this question with regard to both the drum and traction type of elevators.—FAA

Readers' Answers

What Methods Are Best to Check for Phase Reversal?

(This question is from June issue with best answers from readers.)

Our plant has several 19-kv 3-ph 4/0 lead-covered cables feeding an outlying substation. The voltage of our main bus is 11 kv. As the accompanying sketch will show [see June POWER, p 106] *bus voltage is raised to 19 kv by transformers connected delta-wye. There is a common bus at the substation. The system frequency is 25 cycles.*

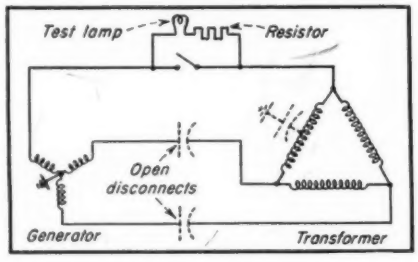
Before restoring the feeder to service after a repair has been made on any cable, it is necessary to make certain that no phase has been reversed. We have been using a glow stick to phase out across the open disconnects at the power-station bus. During this test the repaired cable is energized by closing the three disconnects and the circuit breaker at the substation end. We have some doubt about this method being foolproof because the transformers are between the cable and power-station disconnects.

Have any POWER *readers faced this problem and found a practical solution? We will appreciate hearing about methods of checking for phase reversal that we can apply to our system.—JR*

Simple Lamp Test OK

IN OUR PLANT we have an installation similar to *JR*'s. For many years we have been using a regular tungsten lamp connected in series with five 2200-ohm resistors to make a phase-rotation test. We make this test before returning the feeder to service after it has been worked on.

The test itself is simple; we connect the series lamp-resistor bank across each open disconnect in turn at the generating-station end. If a phase is reversed the lamp will light. We know the test is effective since by connecting test stick between one phase on transformer side to any other disconnect on bus side, the lamp lights.



Now the question is raised, "Well, how does it work since transformer primary is ungrounded and there appears to be no return path for current that lights the lamp?" The answer is capacitative action between the primary transformer winding and ground as well as a similar effect across remaining open disconnects. When a phase is reversed in the feeder, the theoretical voltage between power station bus and primary (delta) of power transformer is double the normal line to line voltage, or 22 kv. Hence the answer is apparent if we can visualize a simple series circuit with two voltages which are 180 deg out of phase, joined through a lamp bank and several condensers. This is shown in above sketch.—**J Sparks, New York, N. Y.**

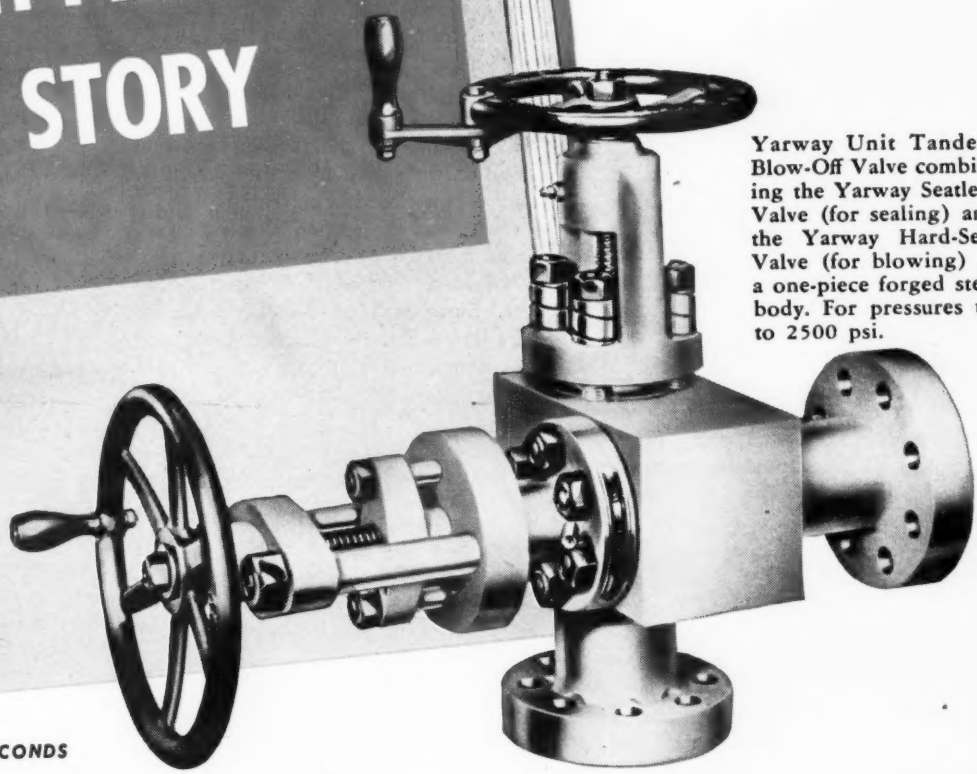
Operating Procedure Using Transformers and Lamps

IF THERE IS adequate clearance to work safely, I suggest *JR* use a glow stick similar to the Schweitzer & Conrad High Voltage Tester, rated 22 kv, to check across each 19-kv disconnect in turn at the substation end. By making test at substation end, a positive circuit is established through the transformer neutrals for the glow-lamp current.

If conditions make it necessary to phase out on the 11-kv side at the generating station, I recommend two 11-kv potential transformers, connected as in sketch on p 110. This connection requires careful checking, as follows:

1. Connect transformers, following polarity marks carefully.
2. Close 11-kv disconnects. Lamps should glow.
3. Close 11-kv ocb. Note line is open at substation. If transformer connections are correct, lamps will not light.
4. Open 11-kv ocb, and block open or pull control fuses so it cannot be closed accidentally. Lamps will again glow.
5. Energize line (and transformer) from the substation. Correct phasing will be indicated by lamps *not* lighting.
6. Open substation ocb; lamps will glow.

A HIGH PRESSURE STORY



Yarway Unit Tandem Blow-Off Valve combining the Yarway Seatless Valve (for sealing) and the Yarway Hard-Seat Valve (for blowing) in a one-piece forged steel body. For pressures up to 2500 psi.

READING TIME: 35 SECONDS

Not once-upon-a-time, but *today*, there is a certain valve that is giving such outstanding satisfaction in boiler blow-down service, that more than four out of every five high pressure boiler plants in the United States use it. That blow-off valve is the Yarway.

The reasons are threefold—excellent design, sound engineering, careful manufacture.

Yarway's famous Seatless Valves have no seat to score, wear, clog and leak. And Yarway Hard Seat Valves, especially suited for high pressure service, have special stellited seats and discs.

Second, constant research, leading to mechanical and metallurgical advancements keeps Yarway Valves ahead of changing service requirements.

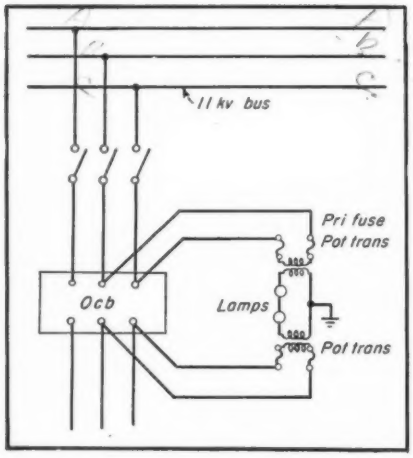
Lastly, forty years of making blow-off valves, has taught Yarway how to make them right.

MORAL—For the best in blow-down service, buy Yarway blow-off valves. Completely described in Bulletin B-432. It's free. Write . . .

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.

Forty Years 1908 YARWAY 1948 STEAM PLANT EQUIPMENT A SYMBOL OF QUALITY AND SOUND ENGINEERING

YARWAY BLOW-OFF VALVES



7. Open 11-kv disconnects and dismantle test connections.

8. Return line to service.

Note that each step of this procedure checks the preceding step. That is, step 2 checks continuity of wiring and lamp filaments; step 3, the connections; step 4 checks lamps before step 5, which is the actual operation of phasing out.

It is assumed that station synchroscope is not connected to 11-kv lines. If it were, *JR* could use it for phasing out the repaired line.—**E E Jones, Gardena, Calif.**

Transformers and Lamps

BEST METHOD I know to check phase reversal is use of simple incandescent lamp in conjunction with potential transformers. This is essentially same method used to synchronize two ac generators.

Three transformers should be used with primary of each connected across the open disconnects at power-station end. When both power-station bus and feeder have the same phase rotation, lamps will not light.—**James J Anderson, St. Paul, Minn.**

Mark Phases Beforehand

I SUGGEST *JR* check phase reversal by installing potential transformers on power transformer side of power-station disconnects; a small 3-phase motor connected across secondaries (hooked in open delta) will give indication of phase rotation.

If *JR* paints an identifying letter on each phase at both ends of every cable, he can use a simple "ringing out" test to check for phase reversal. In this case the test is made between the secondary of the power transformer and the substation ocb.—**Ira A Butcher, Piney River, Va.**

Check With Synchroscope

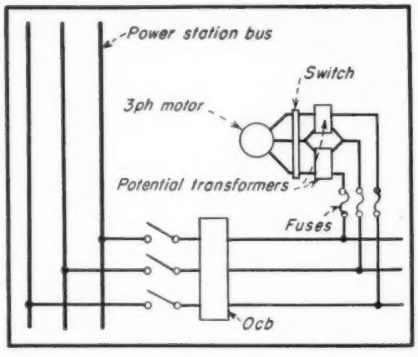
GLOW-STICK METHOD of checking for reversal of phase, which *JR* describes, is satisfactory provided the three phases are tested simultaneously. Although this method is reliable, it presents a definite hazard to the operator.

Rather than the method he now uses, I suggest *JR* adapt the synchroscope on his control board for phasing out. This method may be readily used if the station bus is sectionalized. Let us take the case where the feeder in question comes from section *A* of the power-station bus. During a light load period, all feeds from and to that bus section are dropped off and the ocb opened between sections *A* and *B*. The feeder in question, energized from the substation end, is now closed in on section *A*.

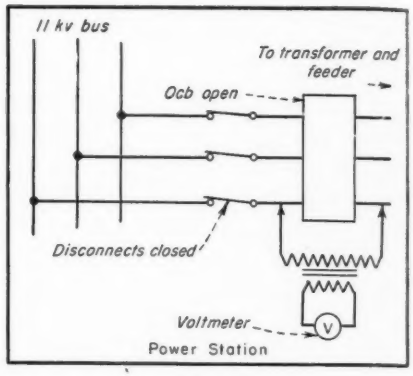
We now have section *A* fed through substation bus which, in turn, is supplied from section *B* of power-station bus. Since each section of bus has its own instrument transformers connected to synchroscope plugs on control board, the problem now is to check that section *A* and *B* are in synchronism. After this check, remaining feeders and generator to that section of bus are returned to service.—**K B Hoffman, Tenafly, N. J.**

Check With Small Motor

SIMPLEST WAY for *JR* to check for phase reversal is to hook up a small 3-phase motor through potential transformers. Knowing rotation of this motor when connected to bus, it is simple to check cable phase rotation (sketch below).



All leads from potential transformer secondaries could be brought to one point and motor with geared hand on a dial connected through interlocking switches. The same idea could be used with phase rotation indicators using resistors, reactors and lamps. I believe the motor gives an indication the operator is less liable to mistake.—**E A Roberts, Carlsbad, N. M.**



Use Ring-Out Test With Dc

JR CAN BEST CHECK phasing of cable with a potential transformer. Connect one transformer primary lead to *A* phase on bus side of open ocb and other primary lead to corresponding phase on cable side as in above sketch. Energize cable from substation end.

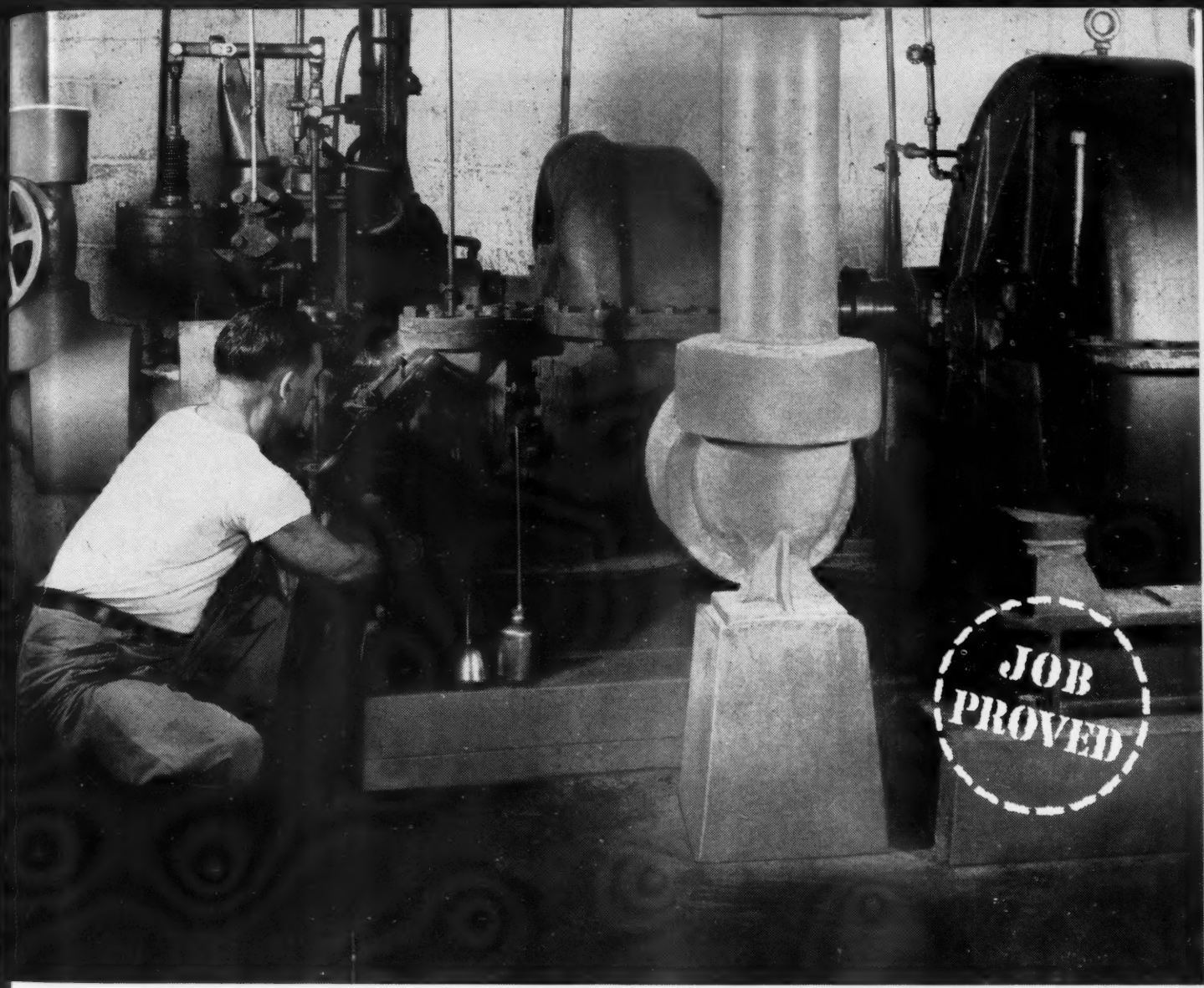
If cable is in phase with bus no current will flow through transformer primary winding. Hence a lamp or voltmeter connected across secondary side will not indicate voltage. All three phases must be checked in the above manner.

Where it is possible to disconnect the cable at each end, a simple system of lettering phases at terminal points will further simplify the phasing problem. When cable is so marked, a low dc voltage may be used with a test lamp in series with one line, the other line connected to cable sheath. At other end of cable, that same lead may be found by use of voltmeter or test lamp connected between cable sheath and lead.—**C Demere, Memphis, Tenn.**

Test With Bus Transformer

I SUGGEST *JR* use a voltmeter in conjunction with a potential transformer instead of a glow stick if he continues this test method. The disconnect should be closed on one phase and voltage measured across the two open disconnects. In this test a single-phase instrument transformer should be used, remembering that it will be subject to about twice normal voltage in case of a reversed phase in feeder.

Since there is probably a 3-phase instrument transformer on bus, I recommend a second transformer be connected on transformer side of disconnects. A permanent connection is made across one phase on the secondary. Voltmeter is connected, in turn, across other two phases. Check transformer polarities.—**P VanHerk, Liege, Belgium**



NO SLUDGE, NO RUST, NO CORROSION

Sunvis 900 Oils Still Like New After 3 Years' Service — Gears and Bearings Show No Wear

In October 1945 a paper mill started up a turbine which had been idle during the war. Sunvis 900 Oils were put in the circulating system and the bath-lubricated gear reduction unit. The operating temperature was about 140°F.

Today, nearly three years later, this equipment still runs on Sunvis 900 exclusively. It requires little makeup. The oils go unfiltered and untreated. No sludge has formed. During the last two summers the equipment stood idle for a few months, exposed to inevitable condensation. Inspected recently, the gears and bearings showed no measurable wear, and were free from rust and corrosion, despite the intermittent operation. The oil is in excellent condition, although never changed.

In all major industries, similar excellent results are being obtained by companies which have adopted Sunvis 900 Oils for preventive maintenance. Sunvis 900 Oils are fortified to resist deterioration and to protect metal parts against rusting and corrosion. These long-lasting, top-quality oils *keep productive machinery running longer*. They can do the same for you. Call your nearest Sun Office, or—for a copy of the illustrated booklet "Sunvis 900 Oils"—write Department P-9.

SUN OIL COMPANY · *Philadelphia 3, Pa.*

In Canada: Sun Oil Company, Ltd.
Toronto and Montreal

SUN PETROLEUM PRODUCTS

"JOB PROVED" IN EVERY INDUSTRY

SUNOCO

NEW PLANT EQUIPMENT

Spreader Stoker E257

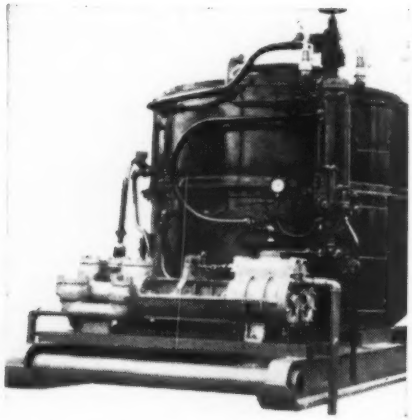
BITUMINOUS COAL-BURNING spreader stoker has (1) hydraulically operated coal pushers (2) an electro-hydraulic drive (3) sectional grate bars.

The electro-hydraulic drive has few moving parts and all operate in a bath of oil. An electric motor or steam turbine supplies power through a helical gear pump for hydraulic mechanism. A control valve regulates oil supply to the hydraulic cylinder, which in turn controls rate of coal feed. **Flynn and Emrich Co, 301 Holliday St, Baltimore 2, Md.**

Voltage Stabilizer E258

DESIGNED TO BE BUILT in as an integral part of electrical equipment, or for use as an accessory, the *VR*-6000 line assures precise ac line-voltage stabilization. The device stabilizes varying input voltage within 1/20 of a second, with an accuracy of plus or minus 0.5%.

Stabilizers having the same voltage and frequency ratings may be connected in parallel for higher wattage output. It is available in standard catalog models or custom-engineered designs, with terminal panels or with cord plugs. **Raytheon Mfg Co, Waltham, Mass.**



Portable Boiler E259

SELF-CONTAINED, rugged portable natural-gas-fired boiler for oilfield service develops 15,000 lb per hr of steam at 500 psi. This 10-ton steam generator is just over 8 ft dia and 9 ft high. Its stack goes 7 ft above the boiler proper.

A gas pilot light ignites the natural-gas fuel. A built-in water pump driven by steam features the new equipment. **Vapor Heating Corp, 4501 W 16th St, Chicago 23, Ill.**

Axial-Flow Pump E260

LARGE-CAPACITY axial-flow pumps, designed to resist sea water and other corrosive liquids, are especially suited to condenser circulation and other services requiring low-cost high-speed pumping of large volumes of liquids. Impellers and suction bells are cast of 25% chrome, 12% nickel stainless steel. Pump shafts are 18-8 stainless. Column and discharge elbows are formed of a high-test cast-iron containing about 2% nickel. These pumps are best fitted for applications where any variation in head is a reduction, and where the resultant increase in capacity is not objectionable. **Economy Pumps, Inc., Hamilton, Ohio.**

Electronic Control E261

HIGHLY SENSITIVE CONTROLS with thermostats free of moving parts give a flexible air-conditioning system, says its maker. Basic units consist of a room thermostat, duct and immersion thermostats, an electronic modulating motor, and an electronic relay. Additional elements may be added with increase in size of area under control.

Operation of control comes from the fact that electrical resistance of a small coil of wire in the thermostat changes with change in temperature. This change is measured through tubes of an electronic relay and amplified to where it can operate control motors to position dampers and valves. **Minneapolis-Honeywell Regulator Co, Minneapolis 8, Minn.**

Check Valve E262

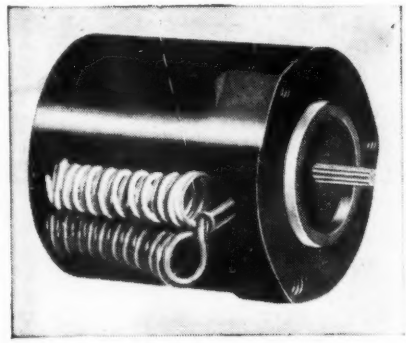
AIRCHECK VALVE is identical in design and construction with the company's *Air-Cushion* valve found in hundreds of compressor installations. Installed in discharge line from an air or gas compressor, check valve prevents leakage of pressure through compressor during the off cycle. Valve guard and seat are firmly locked by a retainer ring that is easily assembled and taken apart. No screws or bolts to burn fast, no parts to jar loose and damage the cylinder. Valve disks and springs are of stainless steel. Entire unit is self contained and operation is automatic. **Pennsylvania Pump & Compressor Co, Easton, Pa.**

Unit Heater E263

DIRECT-FIRED WITH GAS or No. 3 oil *Thermobloc* operates at a reported 80 to 85% efficiency and gives out 550,000 Btu per hr. Unit takes up 30-in. dia. floor space and requires only fuel, electrical and exhaust-gas connections. **Thermobloc Div, Prat-Daniel Corp, E. Port Chester, Conn.**

Arc-Welder E264

AIR-COOLED, engine-driven, 200-amp arc-welding machine has a welding range of 25 to 250 amp at 30 v, 50% duty cycle. *Wasp Special*, a lightweight, easily handled equipment, carries two outlets for lighting purposes or to operate universal power tools. **Dept A 1777 P, Air Reduction Sales Co, 60 E 42nd St, New York 17, N. Y.**



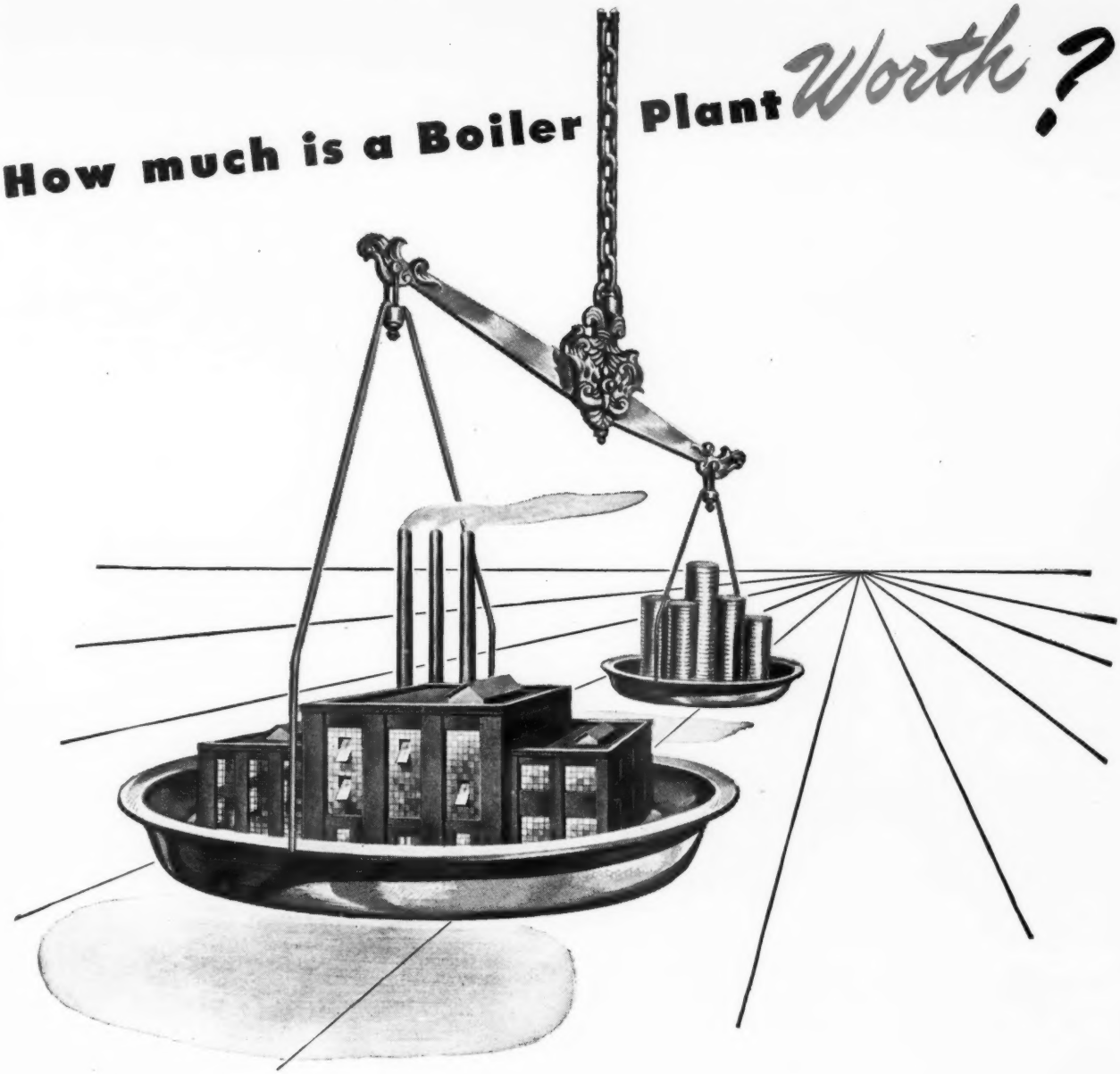
Miniature Motor E265

WEIGHING ONLY 7.6 OZ, the motor serves as a dynamometer for low-value torque measurements, as well as its standard application as a follow-up motor. Objectionable backlash in a train of gears can be reduced by having this motor apply a constant torque.

The motor has maximum torque when stalled and operates continuously under these conditions without overheating. It can be reversed completely in 0.1 sec. It is available in two types: 3000 rpm at 115 v, 60 cycles; and 5000 rpm at 115

Use convenient reply cards on page 178a to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, *E*, and number, as shown on the items above.

How much is a Boiler Plant *Worth?*



A boiler plant may *cost* up to any figure you wish to name.

But a boiler plant's *worth* depends entirely upon how efficiently it operates. For instance, how many or *how few* shut-downs you have may depend entirely on the effectiveness of your water conditioning service.

Correct water conditioning is a matter of careful and scientific control.

W. H. & L. D. BETZ is an organization of engineers and chemists specializing in the solution of all industrial water problems. Years of experience have made Betz water conditioning service scientifically correct . . . complete . . . economical. Our staff of engineers will welcome the opportunity of discussing your boiler water problems . . . W. H. & L. D. BETZ, Gillingham and Worth Sts., Philadelphia 24, Pa. In Canada: Betz Laboratories Limited, Montreal 1.

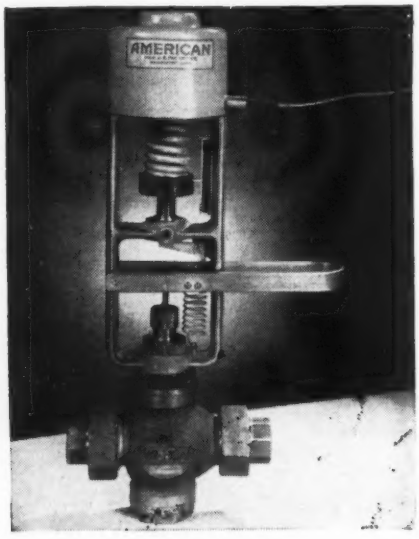
BETZ

BOILER WATER CONDITIONING • COOLING WATER CONDITIONING • INDUSTRIAL WASTE TREATMENT

v and 400 cycles. Each motor is 1.922 in. in length, and 1.719 in. in diameter. **Kollsman Instrument Div, Square D Co, 80-08 - 45th Ave, Elmhurst, N. Y.**

Vacuum Gage Dial E266

VACUUM GAGE DIAL is graduated from 0 to 30 in. mercury vacuum in two-tenths of an inch increments and with barometric pressure readings from 29 to 31 in. Gage dial also reads counter clockwise to prevent any confusion with a pressure gage. **Helicoid Gage Div, American Chain & Cable Co, Bridgeport 2, Conn.**



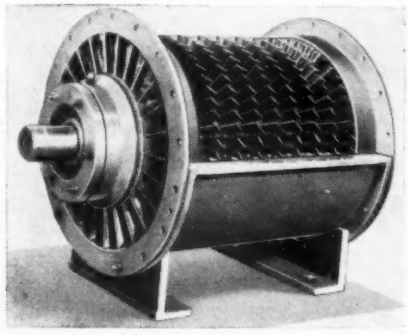
Temperature Regulator E267

POSITIVE, DURABLE, quick-action temperature regulator employs a stainless steel snap action mechanism, stainless steel bulb and line, a bronze valve body and a one-piece bellows. Regulator has a union fitting at the valve for easy-installation in steam line and all that is needed is to put the bulb in the vat holding liquid under process.

To set regulator in operation lift up lever arm on snap action mechanism. Once mechanism snaps it must be reset manually. **Manning, Maxwell & Moore, Inc, Bridgeport 2, Conn.**

Adjustable-Pitch Sheaves E268

ADJUSTABLE-PITCH diameter sheaves are available in 14 sizes, seven single-groove and seven double groove. The single groove sheave has a stationary flange with a hub, bored, keyseated and provided with a set screw for shaft mounting. Outside diameter of the hub is threaded to suit removable flange. It is also milled at 180 deg to receive positioning set screws in the loose flange. Double-groove sheave is identical except that stationary flange is the center spider for the two grooves and is provided with threaded hubs to receive loose flanges on both sides. Design of sheaves is such that the *FO, FA* and *FB*, also *A* or *B*, V-belts can be accommodated through a variable range of diameters. **Worthington Pump and Machinery Corp, Harrison, N. J.**



Compressor E269

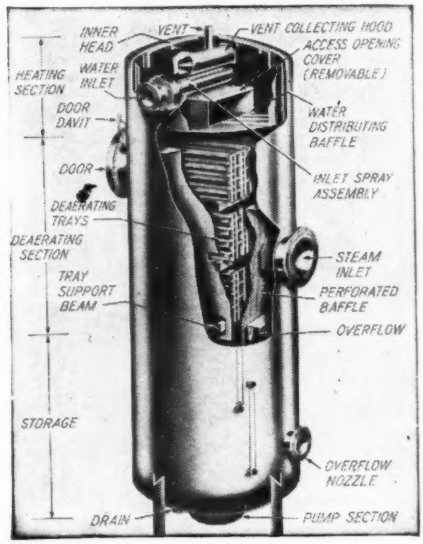
INDUSTRIAL AXIAL-FLOW COMPRESSORS are built to order in capacities from 1000 to 300,000 cfm and pressures up to 100 psi. Manufacturer says operating efficiencies up to 88% have been established by test with a saving up to 20% in power consumption in the larger sizes. Drive may be electrical, steam, or gas turbine. Floor area and general space requirements are said to be less than 10% of those required for other type compressors. **Fredric Flader, Inc, 597 Division St, N. Tonawanda, N. Y.**

Well-Pumping Units E270

A LARGE-CAPACITY, heavy duty pump is for hotels, resorts, institutions and other installations for water service. In 1½ to 5 hp units, with shallow-well capacities up to 60 gpm and deep-well capacities up to 70 gpm in wells up to 260 ft deep. Pump is self-priming and close-coupled to its motor. **Goulds Pumps Inc, Seneca Falls, N. Y.**

Power Drive E271

RIDGID PORTA-POWER DRIVE weighs only 100 lb and was developed for operating hand pipe cutters, threaders and reamers. It has a 3-jaw lathe-type scroll chuck in front and a self-centering work holder in rear that turns with the pipe. Additional features include a special chuck wrench ejector that safely removes a wrench the operator forgets, a bump-proof start and stop switch, and permanent sealed-in lubrication. Unit plugs into any 110-v ac light socket and motor is reversible. It can be mounted on standard pipe legs to form a stand, or bolted to a bench. The unit's capacity is from ⅛ to 2-in. pipe, and up to 8-in. pipe when used with the *Ridgid* universal drive shaft. **Ridge Tool Co, Elyria, Ohio.**



Deaerating Heater E272

ELIMINATION of usual vent-condenser from the deaerator features new design. An inlet non-ferrous spray assembly and vent collecting hood do work of tubes and other parts normally making up the vent condenser. Entire spray assembly can be withdrawn from inlet nozzle.

Except for the inlet spray all parts of heating section are stainless steel. The trays are inspected or removed through an access opening. **Elliott Co, Jeannette, Pa.**

Portable Potentiometer E273

THE INSTRUMENT is suitable for precise measurement of very low voltages. It checks temperature measurement instruments and tests rotating machines, ovens, furnaces, oil-burners, steam-driven equipment and air-conditioning units.

The equipment of the potentiometer, which is contained in a durable, fabric-covered luggage case, includes galvano-

Use convenient reply cards on page 178a to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, *E*, and number, as shown on the items above.

ANKORITE
TRIPLE "U" PACKING

IDEAL FOR RAMS AND PLUNGERS OF ALL TYPES OF HYDRAULIC MACHINES!

Ankorite Triple "U" Packing is ideal for use on high or low pressure hydraulic apparatus working either with oil or water, and may be substituted for the conventional "U" leather hydraulic packings. Its unique construction assures low friction.

Ankorite Triple "U" Packing can be carried in stock in various sizes in continuous lengths from which rings can be cut to suit any diameter rod, plunger or ram.

Let Ankorite Triple "U" Packing solve your difficult hydraulic problems. Write today for full details.

THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.

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Andrews Building . . . . . Buffalo 2, New York
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900 South Wabash Avenue . . . . . Chicago 5, Illinois
174 North Cassingham Road . . . . Columbus 9, Ohio
4 West 7th Street . . . . . Cincinnati 2, Ohio
642 Beaubien Street . . . . . Detroit 26, Michigan
509 Washington Avenue . . . . . Houston 2, Texas
310 Test Bl. . . . . Indianapolis 4, Ind.
720 Mateo Street . . . . . Los Angeles 21, California
903 East Kilbourn Avenue . . . Milwaukee 2, Wisconsin
418 Common Street . . . . . New Orleans 4, Louisiana
100 6th Avenue . . . . . New York 13, New York
401 North Broad Street . . . Philadelphia 8, Pennsylvania
405 Penna Avenue . . . . Pittsburgh 22, Pennsylvania
156 South Park . . . . . San Francisco 7, California
2207 1st Avenue South . . . . . Seattle 4, Washington
1417 Pine Street . . . . . St. Louis 3, Missouri
1529 S. Yorktown St. . . . . Tulsa, Oklahoma

meter, standard cell, working batteries and rheostats for adjusting current through potentiometer circuit. The galvanometer, which is not built in, is furnished with a built-in transformer, hence the galvanometer lamp may be operated from a 115-v, ac, supply line. If field conditions necessitate, the transformers may be readily disconnected and the lamp operated from four No. 6 dry cells. The potentiometer has two ranges, 0-60 and 0-6 millivolts, either of which may be selected by a switch on panel. **General Electric Co, Schenectady 5, N. Y.**

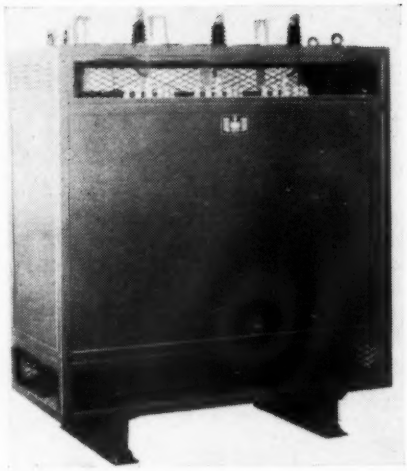
Electronic Relay Control E274

SUITABLE FOR industrial applications where pressure, liquid and temperature controls are required, the *Leveltronic* relay includes control and alarm for liquid level, pressure, flow, temperature, and high foam.

The relay has double-pole, double-throw action with heavy contacts capable of actuating up to ½ hp. Direct and reversing action is available. **R-S Products Corp, Philadelphia, Pa.**

Fire Nozzle E275

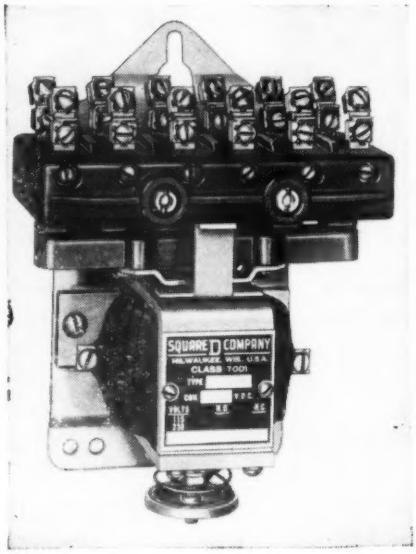
TYPE FFF FOGFOAM NOZZLE, suitable for extinguishing liquid fire, is available in three sizes for service on 1½, 2½ and 3½-in. hose. Nozzle is equipped with a *Fogfoam* screen that discharges a wide protective pattern of *Fogfoam* that can be applied directly to liquid fires. The screen can be removed and replaced with a foam shaper that allows nozzle to discharge a long range of solid foam screen. With the same nozzle you can shut off the foam liquid supply and obtain an excellent high velocity *Waterfog* pattern. **Rockwood Sprinkler Co, 38 Harlow St, Worcester 5, Mass.**



Air-Cooled Transformer E276

A DRY-TYPE TRANSFORMER has Class *B* heatproof insulation, such as air, fiber glass, mica, asbestos, etc. The absence of oil or liquids renders unit fireproof and explosionproof, and therefore eliminates need for fireproof vault. Transformers may be located at load center, reducing length of secondary runs.

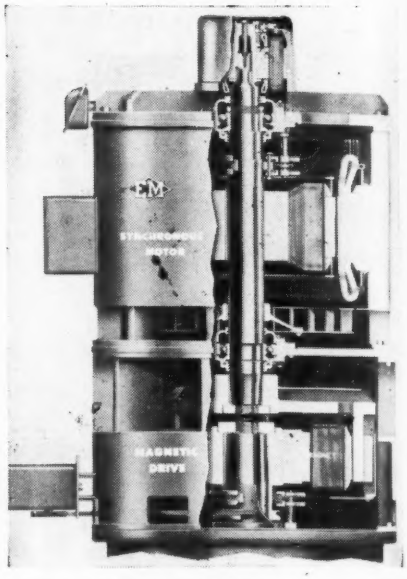
Case protects transformer elements against flooded floor conditions. Provision is made for addition of blowers for forced draft, if future conditions require loading in excess of transformer rating. It is available in sizes from 100 to 1000 kva, single or three phase, in voltages to 15,000 v. **Marcus Transformer Co, 35 Montgomery St, Hillside 5, N. J.**



Dc Relay E277

UTILIZING DOUBLE-BRAKE, silver-to-silver contact, these magnetic multi-pole relays are suitable for machine tool controls. The contact parts are interchangeable with those of the corresponding ac devices, permitting a minimum inventory and simplifying the problem of maintenance.

Relays are steel panel mounted and insulated to permit direct mounting on a grounded metal panel. All terminals are accessible from the front and are equipped with two wiring clips to accommodate multiple connections. *Type Q* relay is available with from two to six poles. *Type R*, somewhat heavier, is available with from two to five poles in any combination of normally open and normally closed circuits. Both relays are suitable for operation on dc voltages up to 250. **Industrial Controller Div, Square D Co, 4041 N Richards St, Milwaukee 12, Wis.**



Vertical Pump Drive E278

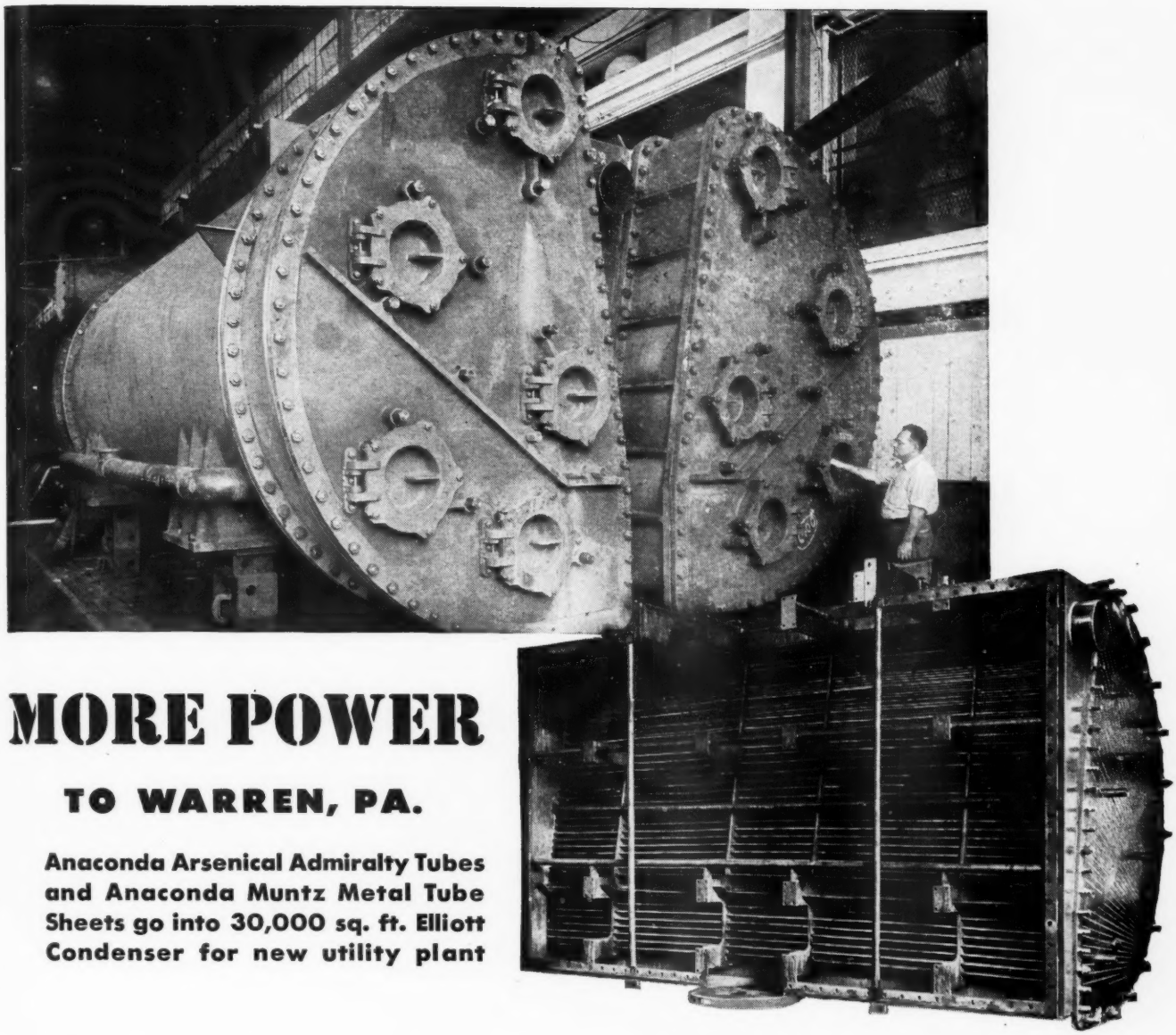
VERTICAL SYNCHRONOUS-MOTOR magnetic-drive unit gives smooth adjustable speed control for centrifugal pumps. Motor powers the ring of the magnetic drive at constant speed. Magnet member of magnetic drive, mounted on gear shaft, operates the pump by liquid-level control at required speed. Unit offers smooth, wide-range speed control, and eliminates frequent motor starts and stops. **Electric Machinery Mfg Co, Minneapolis 13, Minn.**

Lighting Transformer E279

EQUIPPED WITH built-in primary circuit breaker and thermal protection against overload, a new dry-type transformer has been designed to supply industrial lighting and small-power circuits from industrial power circuits. Complete in themselves, the need for primary switches, fuses, or circuit breakers is eliminated.

Circuit breaker handle projects through front of transformer case and is readily accessible. Thermal trip element on circuit breaker prevents damage to transformer from excessive long-time overload, but permits non-damaging short-time surges

Use convenient reply cards on page 178a to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, *E*, and number, as shown on the items above.



MORE POWER

TO WARREN, PA.

Anaconda Arsenical Admiralty Tubes and Anaconda Muntz Metal Tube Sheets go into 30,000 sq. ft. Elliott Condenser for new utility plant

THIS DIVIDED WATER-BOX CONDENSER, manufactured by the Elliott Company, Jeannette, Pa., will serve a 30,000 KW turbo-generator in the new Pennsylvania Electric Company plant at Warren, Pa.

Anaconda Arsenical Admiralty was specified for the 5950 tubes, which are set in 1½" thick tube sheets of Anaconda Muntz Metal. Tubes are ⅞" O.D. x .058" x 22' 3" long.

Arsenical Admiralty Alloy provides all of the advantages of the original Admiralty Alloy . . . high heat transfer and good corrosion resistance . . . plus special resistance to dezincification.

Arsenical Admiralty is but one of eleven standard and several special Anaconda tube alloys for condenser and other heat exchange applications. To help you select the alloys best suited for your needs, our Technical Department will be glad to cooperate with your own engineers or your equipment manufacturer. Also, write for your copy of Publication B-2, which provides detailed information.

45138

ANACONDA
from mine to consumer

Anaconda

CONDENSER TUBES

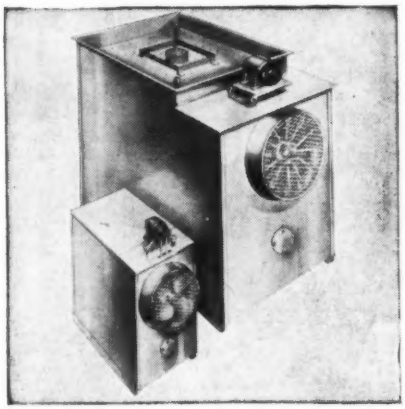
THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company

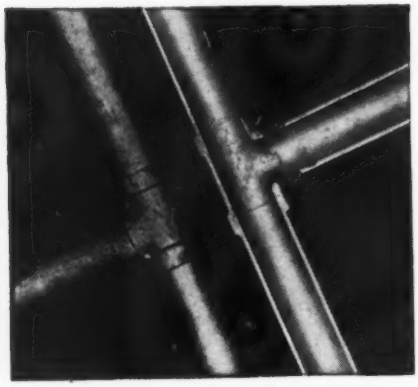
In Canada: ANACONDA AMERICAN BRASS LTD.
New Toronto, Ont.

to be carried safely. The transformers are available with ratings of from 3 through 50 kva for 240 to 120-240 v; 480 to 120-240 v, or 600 to 120-240 v, single-phase, 60-cycle. **Westinghouse Electric Corp, Pittsburgh 30, Pa.**



Cooling Tower E280

ALL-STEEL, integral-welded casing with nailless redwood filling features new line of *Aquatowers* built to answer demand for packaged units to handle up to 50-ton refrigeration. Unit is sent out completely assembled and comes in two general styles, and seven sizes ranging from 3 to 50 tons. **Marley Co, Kansas City 15, Kan.**



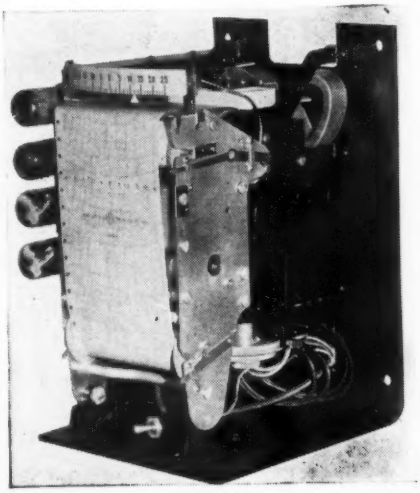
Pipe Fittings E281

FLAGG-FLOW BRONZE FITTINGS are threadless for brazing to *IPS* brass or copper-base alloy tubing or pipe. Fittings are applicable for 150-psi working steam pressure at 450 F, or 300 psi non-shock cold water, oil or gas lines. Full strength of the pipe is utilized, since there is no loss of wall thickness by threading. Fitting tends to reduce turbulence because internal diameter is the same as internal diameter of the pipe or tubing. It can be used to great advantage in confined space where it is difficult to use a pipe wrench. Bronze fittings are an addition to the threadless malleable-iron fittings produced by the same company. **Stanley G Flagg & Co, 1421 Chestnut St, Philadelphia 2, Pa.**

Gas Burner Safeguard E282

ELECTRONIC, flame-failure protection and semi-automatic ignition control for gas-burning equipment, as well as oil-fired ones having gas pilot lights, comes from *Fireye System FF-6*.

It includes an electronic flame rod mounted on the burner plate and projecting into the fire chamber. The rod tip impinges on pilot or main gas flame. When flame fails the rod signals this condition through wire connections to a central system. This control shuts off the fuel and can, if desired, trigger an alarm. **Combustion Control Corp. 77 Broadway, Cambridge 42, Mass.**



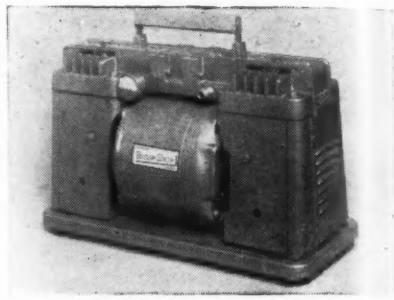
Recording Wattmeter E283

CONSISTING OF a high-speed photoelectric recorder and a newly designed wattmeter measuring unit, this instrument measures dc or ac power. It is particularly suitable for analyzing welding circuits and measuring industrial heating load, motor-starting load, and power surges.

The wattmeter has a linear scale and is available for portable service or for semi-flush mounting. Chart speeds of a half in. per hour up to 72 in. per min can be obtained by using different combinations of chart carriages and rate gears. When calibrated for use on 60-cycles, it may serve over the entire range of from 60 to 10,000 cycles at unity power factor, with an error of plus or minus 5 per cent. Current rating is either 5 or 10 amp, and the potential circuit 110 or 240 v. Current and potential transformers may be used to extend this range. **General Electric Co, Schenectady 5, N. Y.**

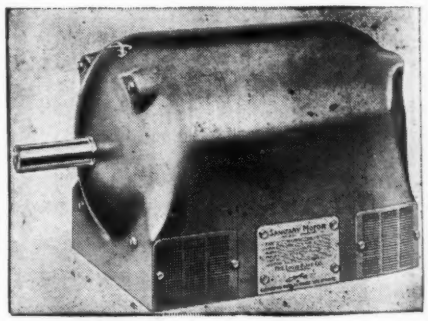
Alloy Valve Stem E284

TYPE RSB, AND ALLOY "6" material, minimize valve-stem thread trouble, formerly a major cause of valve failures. In addition to its wear and abrasion resistance, the new stem alloy is said to resist corrosion and dezincification. **Lunkenheimer Co, Cincinnati, Ohio.**



Air Compressor E285

PORTABLE fractional horsepower air compressor is designed especially to eliminate all contact or contamination of the air with lubricating oil. Model 17*C* delivers 4.4 cfm at 40 psi, and is powered with a ½-hp electric motor. Sealed ball bearings eliminate necessity of oiling and danger of burned-out bearings. Entire mechanism is encased in welded steel frame for greater stability—a new feature of construction in diaphragm type compressors. Model 8-*C* delivers 2.2 cfm at 25 psi, and is powered with a ¼-hp electric motor. A forced-feed oil system assures positive lubrication. Both compressors are particularly adaptable for low-pressure, high-volume work where dependable, quality performance is needed. **Kellogg Div, American Brake Shoe Co, Rochester, N. Y.**



Sanitary Motor E286

STREAMLINED and free of cracks, recesses or depressions where milk or food products may collect, this motor is designed for dairies, food-process, canning and beverage plants. Its totally enclosed, non-ventilated construction, preventing entrance of vermin into the motor when it is shut down, is a feature of the smaller-rated motor. Motors of larger rating are splash-proof, as well as having removable stain-

Use convenient reply cards on page 178a to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, *E*, and number, as shown on the items above.

Steam . . . water . . . oil . . . or gas
CRANE Supplies all Piping equipment

. . . A good thing to remember for a simplified piping job every time . . . on new or replacement installations. No matter what the fluid or working conditions, see the Crane line first for *all* piping equipment . . . and for dependable quality in every item.

For this water supply system, for example, the Crane Catalog puts everything at your finger tips . . . valves, fittings, pipe, and pipe line accessories. One order to your Crane Branch or Wholesaler covers all your needs. From design to erection to maintenance, your piping job moves fast and smooth . . . with good performance assured . . . because you get this 3-way advantage:

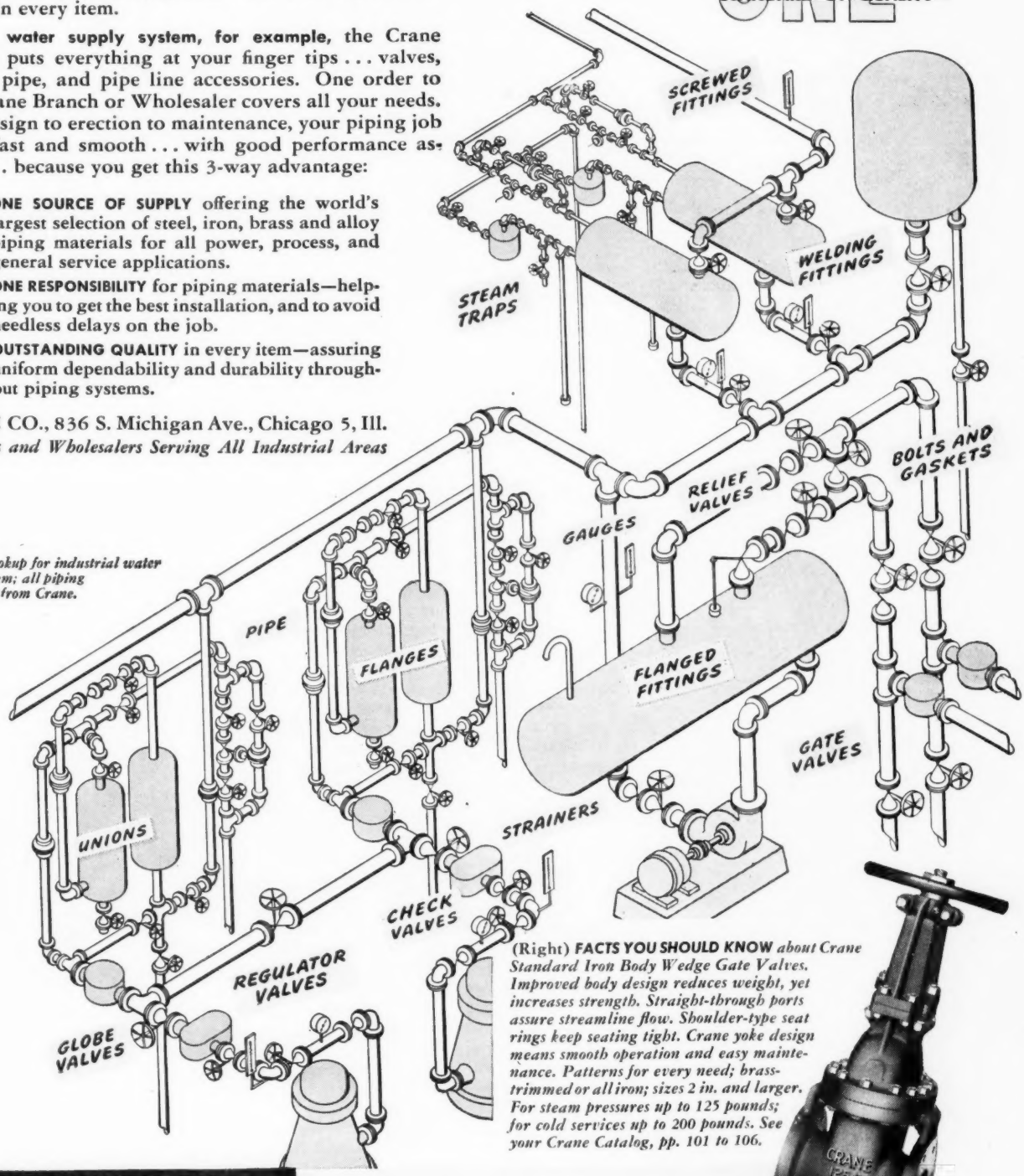
ONE SOURCE OF SUPPLY offering the world's largest selection of steel, iron, brass and alloy piping materials for all power, process, and general service applications.

ONE RESPONSIBILITY for piping materials—helping you to get the best installation, and to avoid needless delays on the job.

OUTSTANDING QUALITY in every item—assuring uniform dependability and durability throughout piping systems.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

ONE
SOURCE OF SUPPLY
RESPONSIBILITY
STANDARD OF QUALITY



Typical hookup for industrial water supply system; all piping equipment from Crane.

(Right) **FACTS YOU SHOULD KNOW** *about Crane Standard Iron Body Wedge Gate Valves. Improved body design reduces weight, yet increases strength. Straight-through ports assure streamline flow. Shoulder-type seat rings keep seating tight. Crane yoke design means smooth operation and easy maintenance. Patterns for every need; brass-trimmed or all iron; sizes 2 in. and larger. For steam pressures up to 125 pounds; for cold services up to 200 pounds. See your Crane Catalog, pp. 101 to 106.*

EVERYTHING FROM . . .

CRANE

VALVES • FITTINGS
PIPE • PLUMBING
AND HEATING

FOR EVERY PIPING SYSTEM

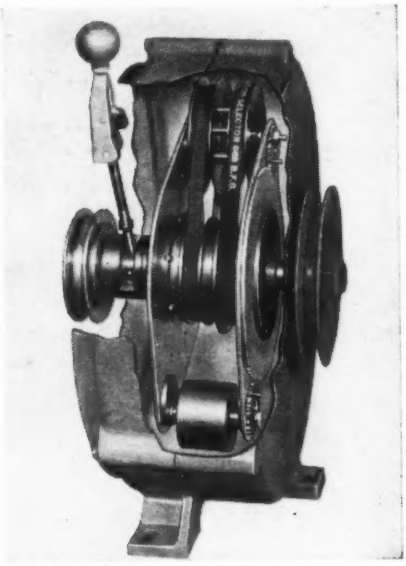
Equipment *Continued*

less-steel grill plates over the cooling-air inlet, making them verminproof. All sizes may be washed down to insure maximum sanitation.

Entire base of this motor is enclosed by the housing, preventing collection of milk or other food particles under the motor. Mounting bolt holes are located in accordance with NEMA standards, permitting this motor to be interchanged with motors now in use. It is available with the Type *C* flange for pump application, and for all standard and special voltages and frequencies. **Louis Allis Co, Milwaukee 7, Wis.**

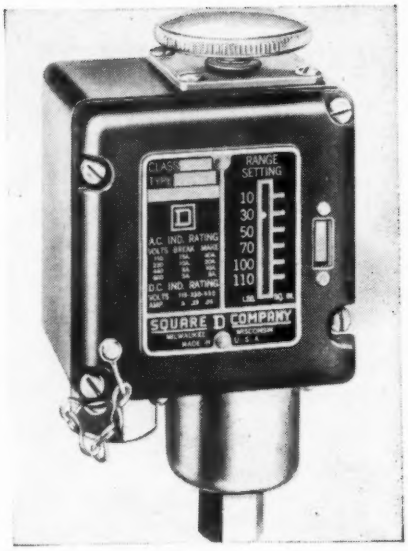
Abrasive Cement E287

ORIGINALLY IN POWDER FORM, addition of water makes a mortar out of *Duracite*, an abrasive cement available in six colors. Manufacturer claims it bonds with slate, marble, concrete, wood, even when applied to a feather-edge of $\frac{1}{16}$ in. Product is reputed to eliminate slip. **Duracite Sales Co, 388 South St, Newark 5, N. J.**



Variable-Speed Drive E288

VARIABLE-SPEED DRIVE uses principle of planetary motion in combination with standard V-belts and variable-pitch sheaves to obtain infinite speed changes from 0 to 800 rpm and into reverse where needed. It has cast-iron sheaves on hardened and ground shafts and guide pins with sealed prelubricated ball bearings, mounted in light cast-aluminum housings. Optional V-belt or flexible-coupling input and output makes the speed selector easily adaptable for mounting in any position on new or existing equipment. It is available in sizes of $\frac{1}{2}$ to 5 hp. **Speed Selector, Inc, 118 Noble Court, Cleveland 15, Ohio.**



Pressure Switch E289

DESIGNED SPECIFICALLY to meet needs of machine tool and welder industries, new switch covers a wide range and diversified applications encountered in control of pneumatic or hydraulic machines. They are suitable for control circuits of welding equipment, machine tools and high-pressure lubricating systems.

Switching inclosures are of die-cast aluminum and are drip-tight and oil resistant. A trip indicator operates behind a window in the cover, permitting easy observation of switch action. This indicator flag facilitates proper setting of trip point and immediately shows any pressure surge or other conditions that might be objectionable. Positive quick-make and quick-break action is assured by use of a precision single-pole, double-throw snap switch mechanism.

Bellows actuated types are available in ranges up to 1,000 psi. Piston actuated controls for hydraulic fields are suitable for pressures up to 3,000 psi. **Industrial Controller Div, Square D Co, 4041 N Richards St, Milwaukee 12, Wis.**

Appliance Plug, Holder E290

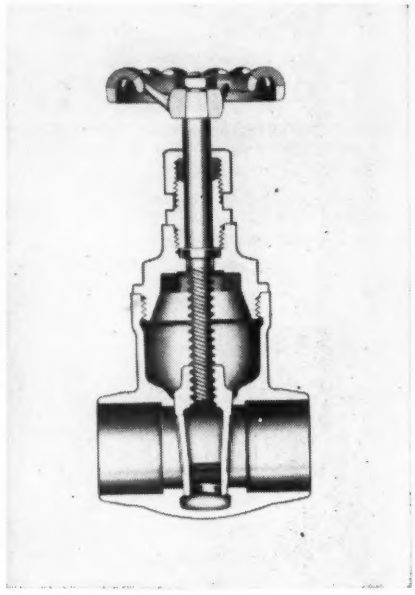
DESIGNED TO MAINTAIN tight connections for all electrical outlets in industrial shops and plants, *Lok-Tite* plug and wall-plate unit prevents accidental disconnection of all portable electrical equipment. Plug is of durable hard rubber attached inside a metal holder. Projecting ears on holder engage under receiver prongs on the wall plate; a quarter turn locks the connection. Suitable for all overhead and hard-to-reach connections, this plug and holder combination reduces lost time because of disconnection of power equipment. Once secure, the plug cannot be pulled out until turned and released. Complete attachment consists of hard-rubber plug, plug holder and wall plate. **Lok-Tite Mfg Co, 1050 Sherman St, Denver, Colo.**

CO_2 Indicator E291

BURRELL CO_2 INDICATOR consists of a transparent plastic barrel with aluminum end caps, inner stainless-steel tube containing a dry absorbing cartridge, metal gravity piston and a gage calibrated to read directly in percent CO_2. Gas sample is forced into the barrel by a rubber hand pump. Indicator is then inverted a number of times, moving piston back and forth in the barrel to push gas sample through absorbing cartridge. Indicator comes complete with cartridge, plastic combustion indicator, sampling pump and tube. **Burrell Technical Supply Co, 1942 Fifth Ave, Pittsburgh 19, Pa.**

Over-Center Clutches E292

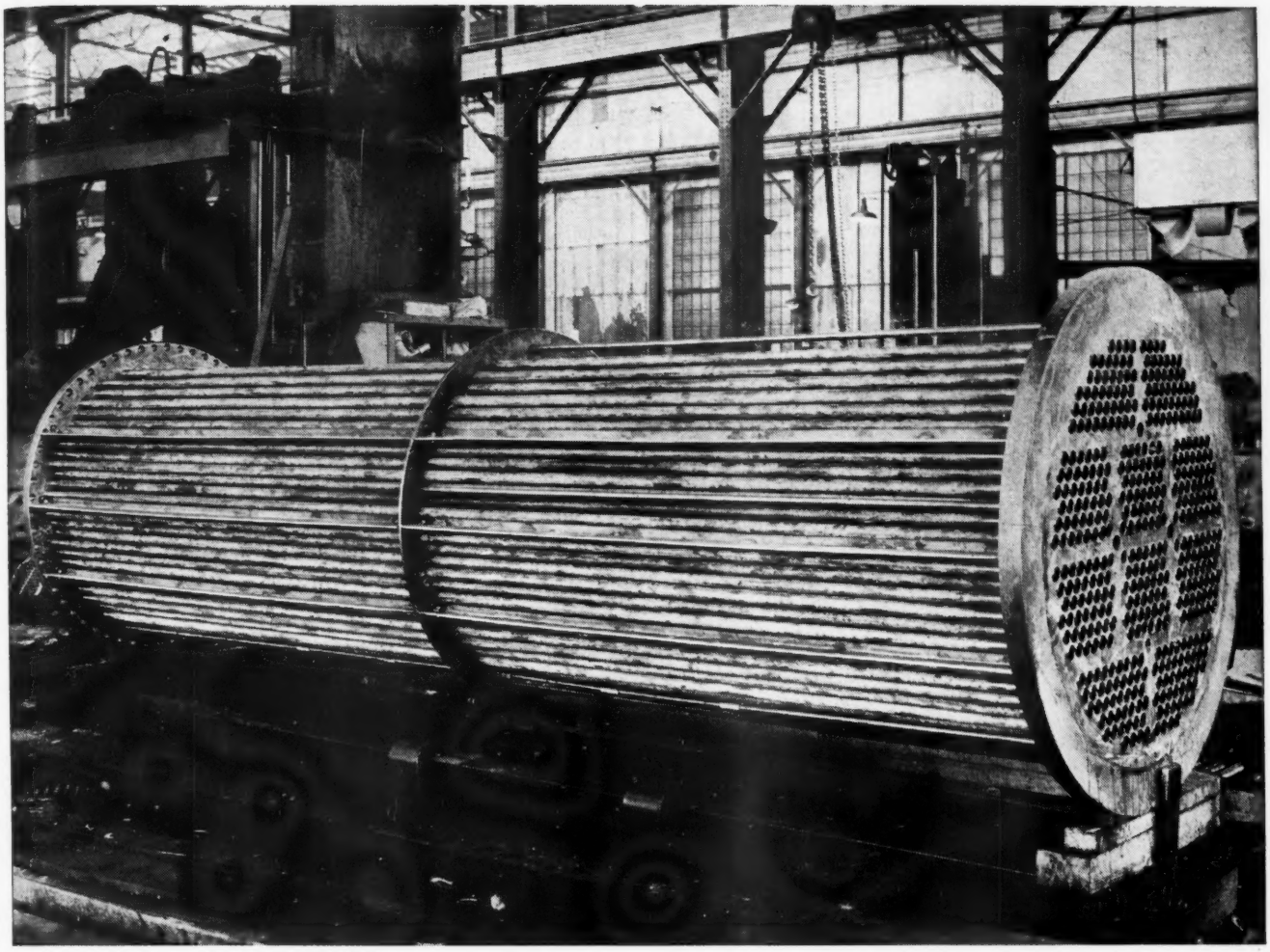
SMALL TOGGLE-TYPE, over-center clutches are adapted for a wide variety of installations. The toggles are factory-assembled with release mechanism and adjusting plate. Entire assembly comes off in one piece when clutch is disassembled. Small-diameter clutches are available in capacities ranging from 0.5 to 1.7 hp per 100 rpm. **Morse Chain Co, 7601 Central Ave, Detroit 8, Mich.**



Gate Valves E293

LINE OF 100-psi brass gate valves are furnished in two types: the No. 410 screwed-end valve in sizes $\frac{1}{4}$ to 2 in. and the No. 1320 solder-joint valve in sizes $\frac{3}{8}$ to 2 in. These are nonrising stem valves, intended to replace Crane No. 449½ and 1319, which are being discontinued. Ends of the soldered-joint design are made to fit closely over hard copper tubing, which enables the solder to flow into the joint by capillary action. Disk is the one-piece wedge type. Valve seats are cast as part of the body. Valve stem can be repacked while under

Use convenient reply cards on page 178a to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, *E*, and number, as shown on the items above.



ELECTRICITY CAN BE CORROSIVE, TOO

OPERATORS of condensers are well-informed and follow sound general practices that should result in satisfactory tube life, but it has been estimated that in about 90% of American plants there is at least one piece of equipment that shows tube trouble. Such cases interest Revere greatly, because we want condenser tubes to give satisfactory, economical service.

Sometimes the causes of premature failure are obscure and difficult to discover. One of them is stray electricity. When you remember that copper plating is usually done at about 4 to 6 volts, you can see that it doesn't take much to move metal from one place to another through a fluid. Any flow of current through a condenser is sure to be destructive.

Electricity often finds strange routes to ground through high-resistance shorts that do not show up through blown fuses, overheated parts, arcing, and similar obvious indications. Pump motors, for example, may work perfectly well, but permit a little "corrosive" electricity to pass along to ground through the condenser; electrolysis results. Galvanic action, due to the use of metals of too-great dissimilarity, may also occur, but is rare in a condenser properly designed for its operating conditions.

So Revere suggests you include electricity as a possibility when seeking the causes of unexpected tube failure. And it is also advisable to save samples cut from failed tubes, to be sent to Revere for laboratory examination. Facts thus scientifically uncovered may lead to recommendations that will solve the problem. If you have a condenser tube problem, ask Revere to help.

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COPPER AND BRASS INCORPORATED

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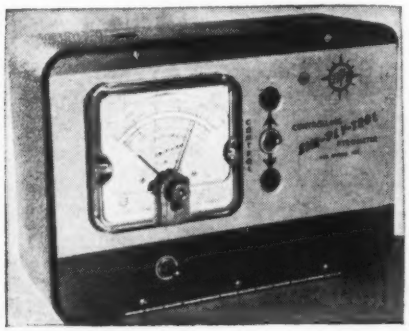
Sales Offices in Principal Cities, Distributors Everywhere

Equipment *Continued*

pressure when valve is wide open. Specific working recommendations allow the valves to be used with saturated steam at working pressures up to 100 psi and for water pressures up to 125 psi at 200 F. For such conditions the solder joint must be made with high-melting-point solder. **Crane Co, Chicago, Ill.**



Pyrometer E294

SIMPLYTROL indicating and controlling pyrometer operates on the recently developed *Micro-Contact* principle. *Micro-Contact* circuit is interrupted every few seconds, but closes again immediately if temperature is still up to control point. If temperature has dropped below control point, the contacts remain open and time-delay load-control switch closes. Load-control switch is rated at 10 amp, 125 v. Indicators are calibrated in both Fahrenheit and Centigrade, and are available in standard ranges of 0 to 2500 F, and 1370 C; 0 to 1500 F, and 800 C; 0 to 500 F, and 260 C. Pyrometer operates from regular 110- or 220-v ac, or 110-v dc circuit. **Assembly Products, Inc, Main & Bell St, Chagrin Falls, Ohio.**

Magnetic Gas Valve E295

HERMETICALLY SEALED magnetic gas valve, Model *K-3H*, combines advanced design and operational features to eliminate gummy or foreign matter deposits forming in the solenoid and restricting plunger operation. Diaphragm construction seals operating mechanism from the fuel gas without interfering with valve operation. Valve closes automatically upon current failure. Opening and closing gas-fuel supply in response to room thermostats, limit controls or similar devices, the valve is adaptable to gas-fired boilers, industrial furnaces and conversion burners. Valve is available in sizes $\frac{3}{8}$ to $1\frac{1}{4}$ in., inclusive. A simple lever-opening device permits setting the valve in open position if current fails. Same lever may be used to close the valve manually. Upon resumption of current flow, an electric trip automatically returns valve to normal. **General Controls Co, 801 Allen Ave, Glendale 1, Calif.**

Flue Cleaner E296

REINFORCED Swedish spring steel blades have 44 cutting edges that shave off flue dust accumulations, claims its manufacturer. Assembly mounts on an octagonal steel shaft and connects to any fire-tube cleaning rod. **Goedert Flue Shaver Co, 609 Madison St, Oak Park, Ill.**

Time Switch E297

THIS NEW TIME SWITCH may serve in stores to operate window lights and in industry for controlling ovens and other small equipment. The switch is known as *Type T-47*, rated 35 amp at 115 and 230 v.

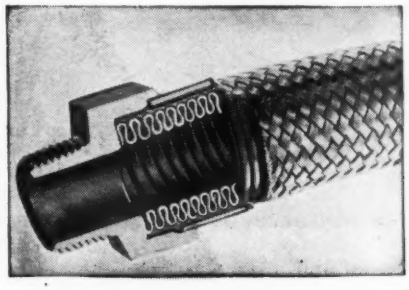
Designed for on and off timing of a single circuit, the new switch will perform one on and one off operation during any 24-hr period, and will continue to do so daily without adjustment. Silver snap-action contacts are fitted in the single-pole, single-throw mechanism of the switch. It is equipped with a large 24-hr clock dial easily read and adjusted. Manual operation of either on or off is possible independently of automatic setting already placed on the dial. Switching cycle is resumed automatically after hand operation is completed. **General Electric Co, Schenectady 5, N. Y.**

Shaft Seal E298

TYPE PS MECHANICAL SEAL may be installed on practically any type of pump, mixer or like equipment having a rotating shaft. No special sleeves are required, and the seals can serve on either motor or turbine-driven equipment. Seal is easily installed in conventional stuffing boxes on new or old equipment, only $\frac{1}{2}$-in. packing space is required. It provides dry sealing for propane, butane and other hydrocarbons. No auxiliary lubricating system is needed. **Durametallic Corp, Kalamazoo, Mich.**

Portable Welder E299

GASOLINE ENGINE-DRIVEN, lightweight, portable machine is air-cooled with adjustable speed for control of welding current (from 20 to 180 amp). *Lincwelder*, 2 ft wide by 2 ft high and 4 ft long, weighs 502 lb and has an output panel with three ranges of output current. **Lincoln Electric Co, Cleveland 1, Ohio.**

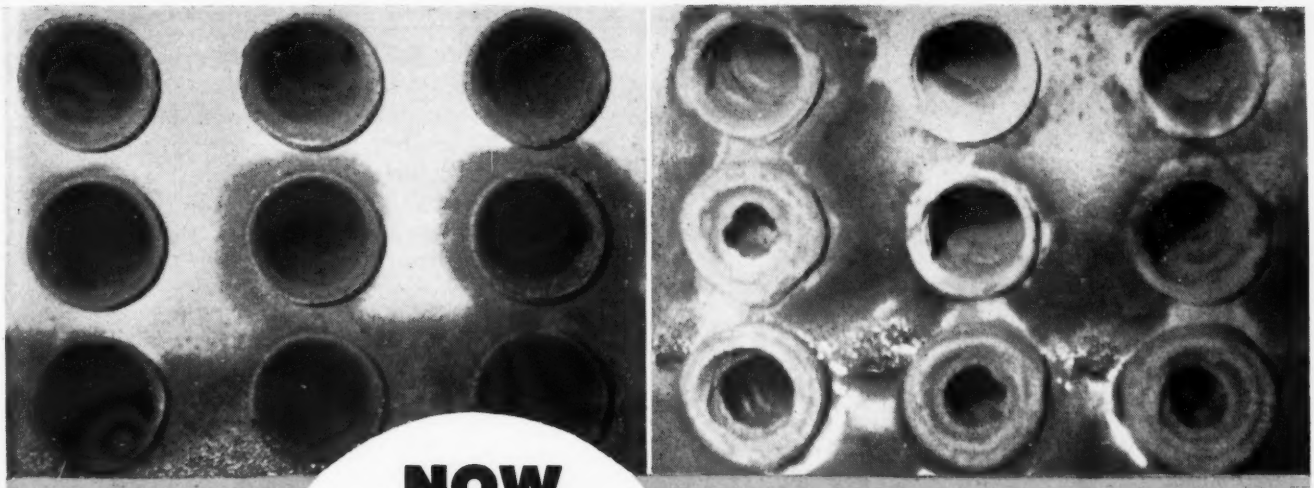


Quick-Soldered Coupling E300

FLEXIBLE-HOSE SOLDERED COUPLINGS are for service where temperatures do not exceed 300 F. Couplings are available either assembled on hose in factory or can be purchased separately and assembled on the job. Coupling is a 2-piece male type including a male body and loose collar. Collar is designed so that when the hose is cut it holds the braid tight, to prevent unraveling and slipping, thus producing a hose and braid end ready for soldering. When soldered to body coupling, it becomes one solid unit.

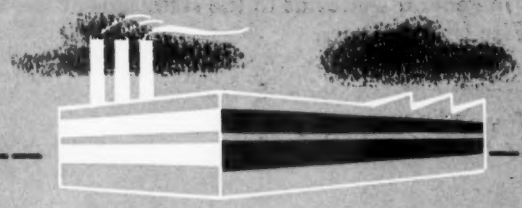
(*Continued on page* 134)

Use convenient reply cards on page 178a to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, *E*, and number, as shown on the items above.



• *Two views of the same tube ends in high pressure, 85% make-up boiler . . . at right, just before Nalco treatment; at left, after one month with Nalco — no washing or mechanical cleaning.*

NOW *Nalco* water treatment service for EVERY PLANT!



Thousands of plants, large and small, high pressures and low, know the economy and security of the complete Nalco System of Water Treatment. From raw water intake through condensate disposal, Nalco-protected equipment and piping *stays on the job* . . . scale- and corrosion-free, permanently.

Successful water treatment is seldom, if ever, a one-call job. Nalco Service does not stop with a survey and recommendations . . . As long as you have the Nalco System — and many plants have had it 20 years or more! — you get the full benefits of the scientific and engineering skill that make Nalco the permanently successful system of water treatment.

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THE *Nalco* SYSTEM

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How to plan a STANDPIPE SYSTEM WITH SINGLE ROOF TANK FOR FIRE LINE AND DOMESTIC WATER SUPPLY

Another in the series of basic Piping Layouts prepared by Jenkins Bros.

A typical standpipe system using a single roof tank for both fire line and domestic water supply is shown in this diagram. It is applicable to apartment houses, office buildings, industrial plants, hospitals and other institutions not exceeding 300 feet in height. The layout in general conforms to the standards of the Board of Fire Underwriters.

A roof gravity tank, located high enough above topmost outlets to assure sufficient water pressure at all times, provides the primary water supply for the standpipe system and for domestic use throughout the building. The standpipe fire reserve is below the hot and cold water outlets to assure standpipe water supply in the event of failure in the main water supply line. Some codes require the roof tank to be heated to prevent freeze-up, while others depend upon the constant movement of the general supply to the building.

The roof tank is supplied with water from a centrifugal pump in the basement, or directly from the street main if pressure is sufficient. In either case, the roof tank is float controlled to avoid waste.

The standpipe system has two risers, cross connected at the top and bottom of the system. This allows one riser to be shut down for repairs while the other remains in service. The bottom cross connection is tied into the street siamese connection for attachment to fire department pumps.

Water supply valves are bronze and standpipe system valves are iron body bronze mounted for maximum resistance to corrosion. O.S.&Y. Gates are recommended for shut-off services to indicate at a glance the open or closed position as required by the code.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installation. Copies of Layout No. 38 will be sent on request. Just mail coupon.

Fig. 715-A, Bronze Fire Line Angle Valves, are recommended for hose valves in this layout. Approved by the Board of Standards and Appeals of the City of New York, they have a clear waterway area of more than 5 sq. in. Resiliency of composition disc assures drop tight closure with least closing effort.

Jenkins PRACTICAL PIPING LAYOUTS

Illustrating the proved 3-point formula for trouble-free, time-defying hookups

A Use the right type valve for the service.
B Place valves correctly in the line.
C Choose Jenkins Valves for lifetime economy.

38

Fig. 715-A
BRONZE
FIRE LINE ANGLE VALVE
Renewable Composition Disc
Red Enameled Wheel
Closes tightly against 300 lbs. hydraulic pressure under normal conditions. Withstands hydrostatic test-pressure of 750 lbs. p.s.i.

A CHOICE OF OVER 500 VALVES

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering experience, select all the valves you need from the Jenkins Catalog. It's your best assurance of *lowest cost in the long run.*

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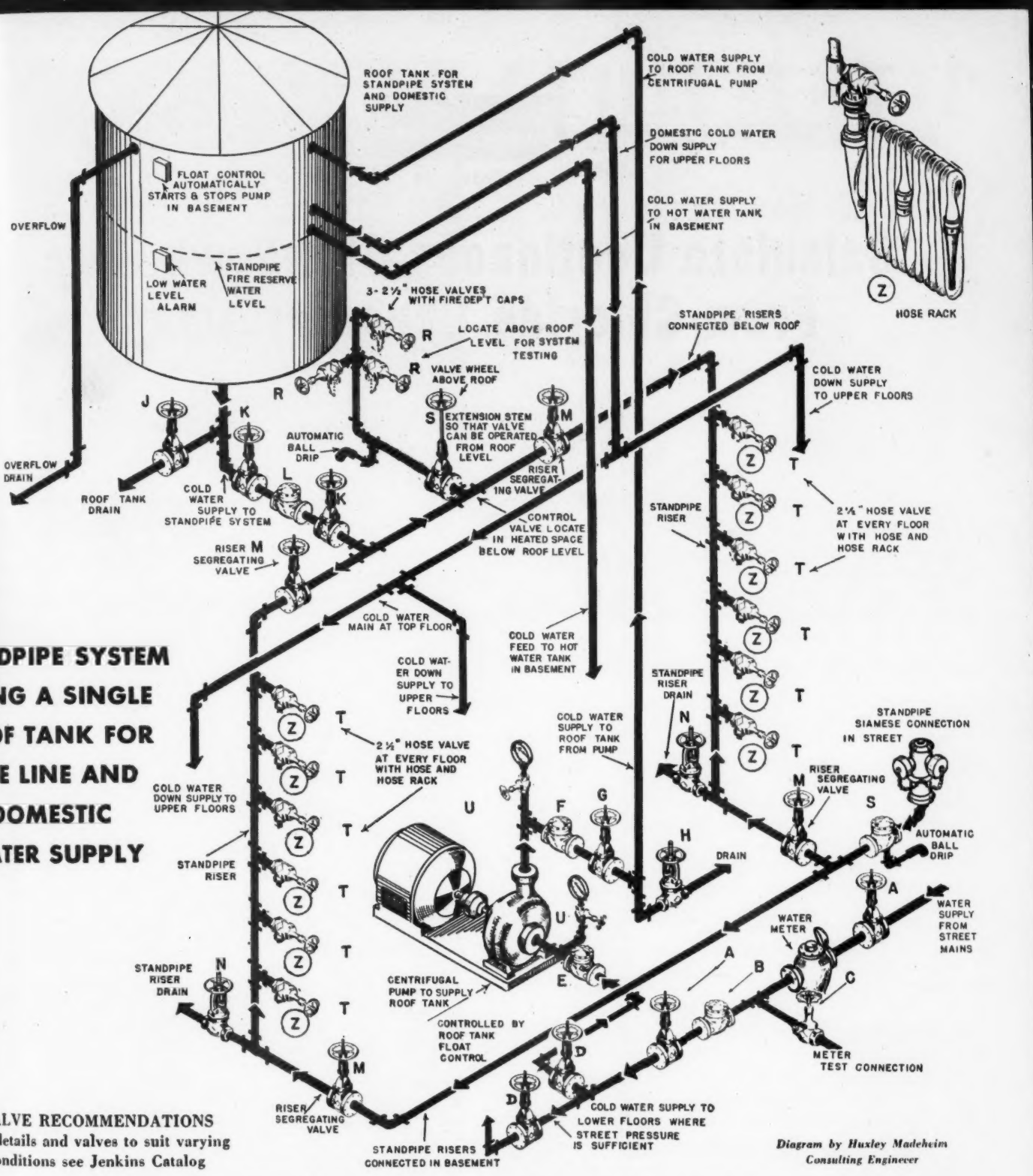
ROOF TANK FOR STANDPIPE SYSTEM AND DOMESTIC SUPPLY
COLD WATER SUPPLY TO ROOF TANK FROM CENTRIFUGAL PUMP
DOMESTIC COLD WATER DOWN SUPPLY FOR UPPER FLOORS
COLD WATER SUPPLY TO HOT WATER TANK IN BASEMENT
FLOAT CONTROL AUTOMATICALLY STARTS & STOPS PUMP IN BASEMENT
OVERFLOW
LOW WATER LEVEL ALARM
STANDPIPE FIRE RESERVE WATER LEVEL
3-2½" HOSE VALVES WITH FIRE DEP'T CAPS
LOCATE ABOVE ROOF LEVEL FOR SYSTEM TESTING
VALVE WHEEL ABOVE ROOF
EXTENSION STEM SO THAT VALVE CAN BE OPERATED FROM ROOF LEVEL
AUTOMATIC BALL DRIP
RISER SEGREGATING VALVE
OVERFLOW DRAIN
ROOF TANK DRAIN
COLD WATER SUPPLY TO STANDPIPE SYSTEM
CONTROL VALVE LOCATE IN HEATED SPACE BELOW ROOF LEVEL
RISER M SEGREGATING VALVE
COLD WATER MAIN AT TOP FLOOR
COLD WATER FEED TO HOT WATER TANK IN BASEMENT
COLD WATER DOWN SUPPLY TO UPPER FLOORS
2½" HOSE VALVE AT EVERY FLOOR WITH HOSE AND HOSE RACK
COLD WATER DOWN SUPPLY TO UPPER FLOORS
STANDPIPE RISER
STANDPIPE RISER DRAIN
COLD WATER SUPPLY TO ROOF TANK FROM PUMP
STANDPIPE SIAMESE CONNECTION IN STREET
RISER SEGREGATING VALVE
AUTOMATIC BALL DRIP
DRAIN
WATER SUPPLY FROM STREET MAINS
WATER METER
CENTRIFUGAL PUMP TO SUPPLY ROOF TANK
CONTROLLED BY ROOF TANK FLOAT CONTROL
METER TEST CONNECTION
COLD WATER SUPPLY TO LOWER FLOORS WHERE STREET PRESSURE IS SUFFICIENT
STANDPIPE RISERS CONNECTED IN BASEMENT
HOSE RACK
STANDPIPE RISERS CONNECTED BELOW ROOF

STANDPIPE SYSTEM USING A SINGLE ROOF TANK FOR FIRE LINE AND DOMESTIC WATER SUPPLY

VALVE RECOMMENDATIONS
For details and valves to suit varying conditions see Jenkins Catalog

Diagram by Huxley Madeheim Consulting Engineer

Code	Quan.	Jenkins Valves	Service
A	2	*Fig. 825 I.B.B.M. Gate	Main Water Supply Shutoffs
B	1	*Fig. 629 I.B.B.M. Swing Check	Prevent Backflow to Mains
C	1	Fig. 106-A Bronze Globe	Water Meter Test Valve
D	2	*Fig. 825 I.B.B.M. Gate	Cold Water Supply Shutoff
E	1	*Fig. 629 I.B.B.M. Swing Check	Prevent Backflow from Pump
F	1	*Fig. 629 I.B.B.M. Swing Check	Prevent Backflow to Pump
G	1	*Fig. 825 I.B.B.M. Gate	Centrifugal Pump Discharge
H	1	Fig. 275-U Bronze Gate	Pump and Riser Drain
J	1	Fig. 651 I.B.B.M. Gate	Roof Tank Drain
K	2	Fig. 825 I.B.B.M. Gate	Roof Tank Shutoff

Code	Quan.	Jenkins Valves	Service
L	1	Fig. 629 I.B.B.M. Swing Check	Prevent Backflow to Roof Tank
M	4	Fig. 825 I.B.B.M. Gate	Standpipe Riser Segregation
N	2	Fig. 275-U Bronze Gate	Riser Drains
P	1	Fig. 825 I.B.B.M. Gate	Control Valve for Roof Test Hose Valves
R	3	Fig. 715-A Bronze Angle Hose	Roof Test Manifold
S	1	Fig. 629 I.B.B.M. Swing Check	Prevent Standpipe Water Draining thru Siamese
T	12	Fig. 715-A Bronze Angle Hose	Hose Shutoffs
U	2	Fig. 741-G Bronze Needle	Pressure Gage Control

*All Bronze Valves optional

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125 TO 600 LBS. STEAM PRESSURE

POWER'S
DATA SHEETS

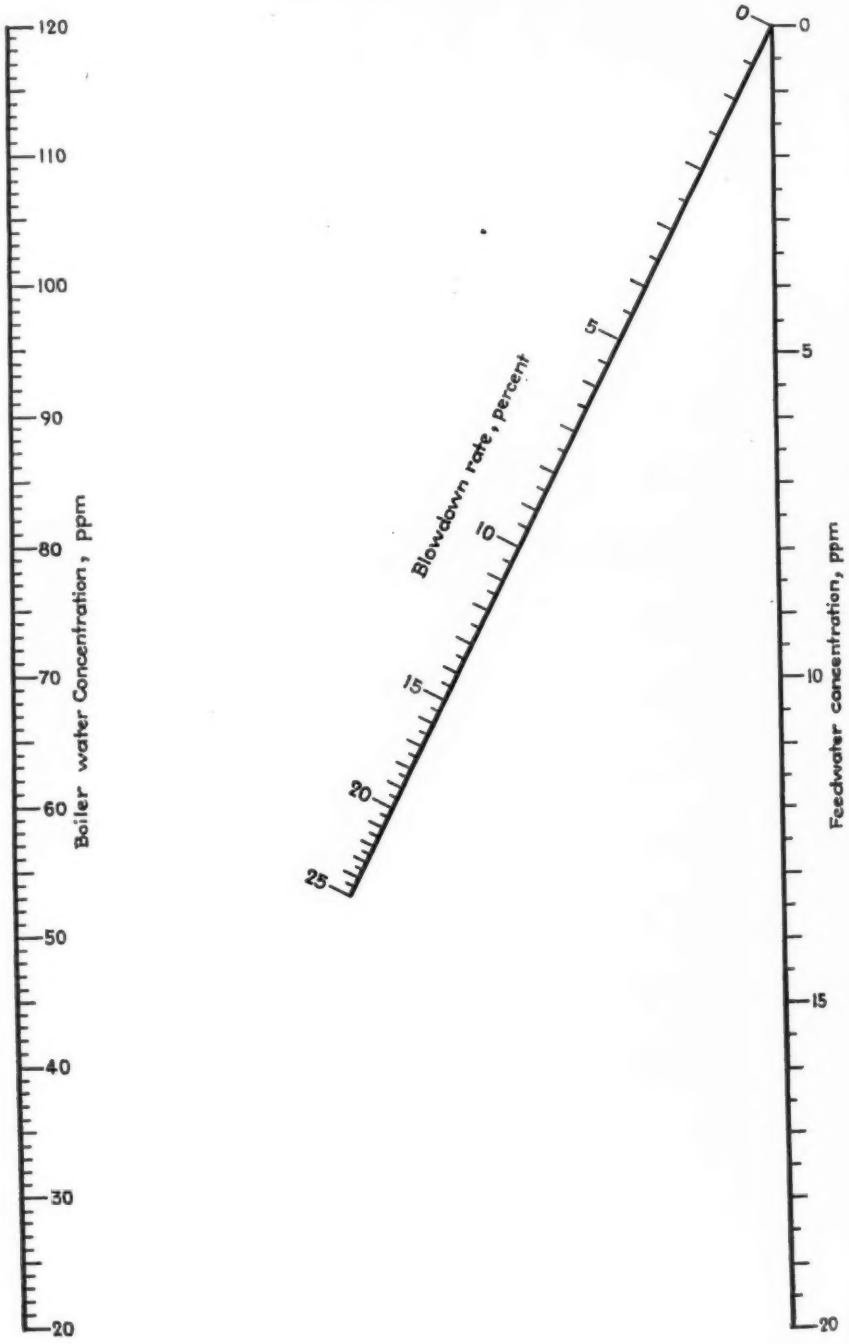
NUMBER 194

Calculate Continuous Blowdown Rate From Chloride Concentrations

▶ WHERE CONTINUOUS BOILER BLOWDOWN must be used to keep the dissolved solids within specified limits, the smaller blowndown flow must carry out the same amount of impurities carried in by the feedwater entering the drum. The chloride concentrations in feedwater and boiler water can be used to calculate the percentage rate of blowdown needed to maintain constant boilerwater concentration.

Chloride concentrations can be determined by titrating the samples with silver nitrate solutions, using potassium chromate as an indicator. To find the blowdown rate as a percent of feedwater flow, locate the boiler-water and feedwater concentrations on their respective scales in the nomogram, lay a straight edge between these two readings, and read the blowdown rate at its intersection with the center inclined scale.

By John F Hyam



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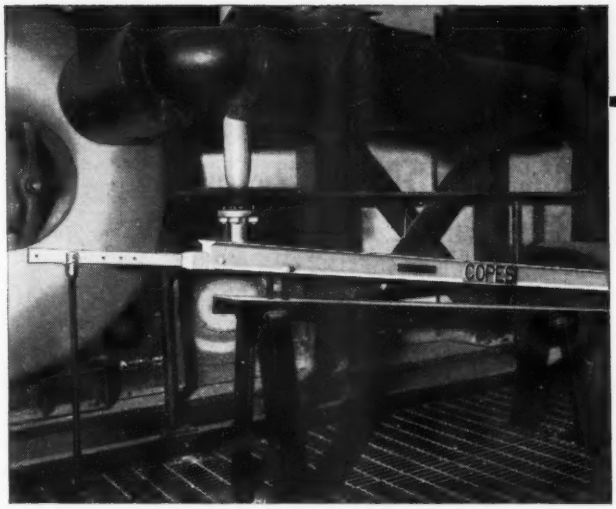


The water-level element is the COPES Thermostat which is rugged, reliable and accurate in service

FLOWMATIC

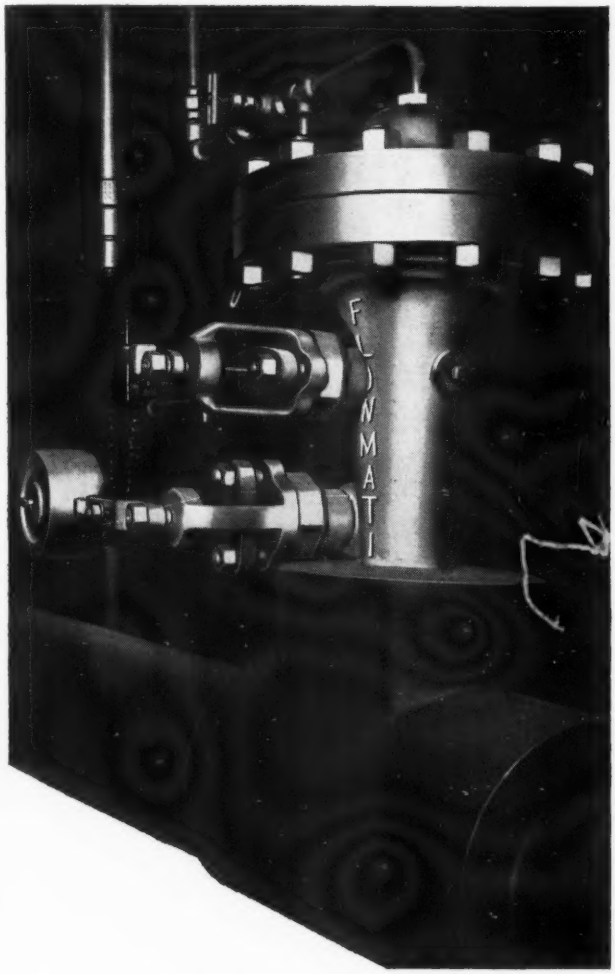
at

MUNICIPAL POWER PLANT
MONROE, LOUISIANA

Holds

BOILER WATER LEVEL

WITHIN *Plus* OR *Minus* 1/2 INCH



Direct-operated COPES Flowmatic Valve has the steam-flow element built integral with the bonnet

COPES Boiler Feed Water Regulators had been in service since 1924 at the Municipal Power Plant, Monroe, Louisiana. They had required no more than routine attention by plant personnel. So, when the 400-psi extension was planned, it was only natural to select the modern two-element COPES Flowmatic for the gas-fired Babcock & Wilcox boiler. Results have been all that could be desired. Water level is held within plus-or-minus one-half inch. Write for Performance Report 473 which tells the story.

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981 GROVE DRIVE, ERIE, PENNSYLVANIA
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Boiler Feed Water Control . . . Excess or Constant Pressure Control, Steam or Water . . . Liquid Level Control . . . Balanced Valves . . . Desuperheaters . . . Boiler Steam Temperature Control . . . Hi-Low Water Alarms.

TECHNICAL BRIEFS

ENGINEERING DEVELOPMENTS HERE AND ABROAD DIGESTED FOR BUSY POWER MEN

REVIEWED IN THIS ISSUE

PANEL HEATING

Present Status of the Panel Heating Art
Comparative Performance: Panel, Convection
Steam Heating Control Practice
Application of Heat Balance Analysis

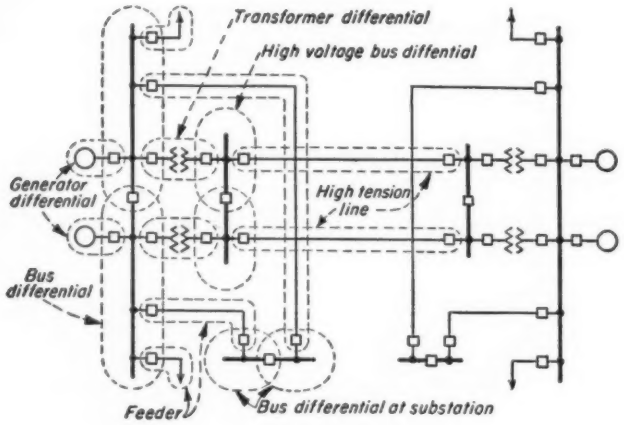
POWER RELAYS

Principles and Practices of Relaying in the United States

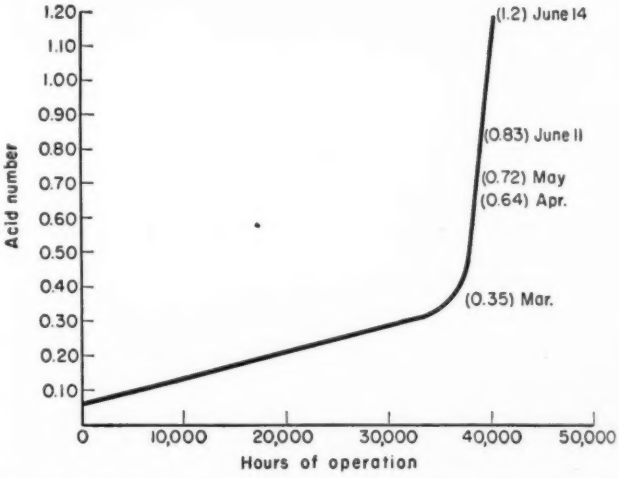
TURBINE OILS

Service Experience With Turbine Oils, as Reported for a Range of Turbine Installations in an Industrial

Directions for ordering papers are given on page 130



1 Typical power system with overlapping relay protective zones. Adequate relaying disconnects small section of fault



2 Typical analysis for type B turbine oil. Sludging accompanies rapid rise in acid number. Interfacial test was later adopted

POWER RELAYS

Principles And Practices of Relaying In The United States, *by W E Marter, Duquesne Light Co and E L Harder, Westinghouse Electric Corp.* After reviewing general principles of relaying, the paper covers operation of basic elements in commonly used relays. Among these are instantaneous, induction, multiple-disk, balance-beam units, and various combinations.

Relay practice in connection with generator protection is outlined, covering both stator winding and field protection. Differential relaying is used generally to protect stator windings against grounds and short-circuits within the machine zone of protection. General trend is towards using relays to detect undervoltage as well as undercurrent in machine's field circuit.

In protection of transformers, differential relaying continues to be the principle form of relay protection. A suppressor is generally provided to temporarily desensitize the relay for a time interval sufficient to allow inrush current to die out. Use of gas-pressure, gas-accumulator and thermal relays on transformers is discussed in this AIEE paper.

Satisfactory bus protection is often obtained with a straight differential relay scheme. Multi-restraint ratio-differential relays will not operate falsely even when used with normal-size current transformers, which saturate due to the dc component of current under fault conditions. The paper includes a general discussion of linear coupler and impedance schemes as well as directional relays in connection with bus protection.

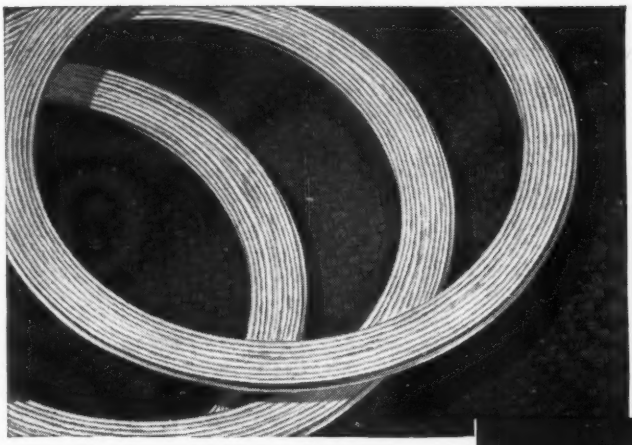
In addition to a general discussion of high-voltage line protection, principles of pilot wire and carrier-pilot relaying are covered. General practice in connection with motor protective relaying is also presented.

The general idea of providing overlapping protective zones, shown in sketch above, is stressed in this paper. List of subject references is included as well as schematic sketches showing relay components and vector analysis. Several one line diagrams, Fig. 1, are shown which illustrate typical protective relay problems and their solutions. *AIEE Paper No.* 48-186.

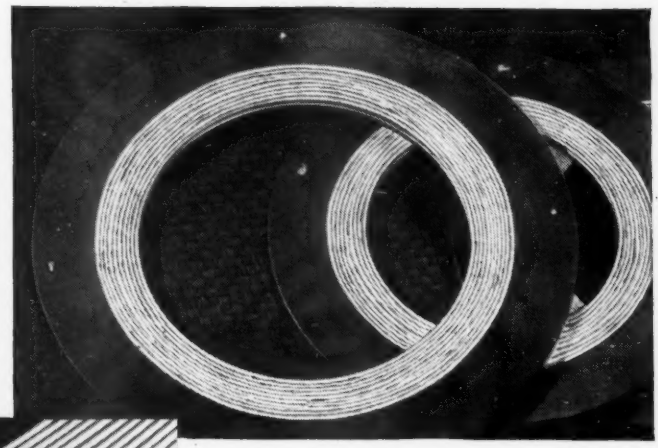
TURBINE OILS

Service Experience With Turbine Oils, *by C L Pope and O V Sprague, Eastman Kodak Co.* The paper was written to furnish the results of operating experience on lubricating systems of steam-turbine generating equipment at Kodak Park, Rochester, N. Y. Turbines in this plant range from 1500 to 5000 kw with steam at 260 psi, 576 F and 800 psi, 750 F. All turbines operate with a centrifuge continuously bypassing the oil.

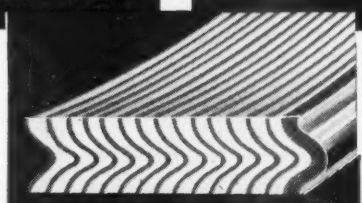
Weekly inspection of the centrifuge is made and monthly oil samples are taken, analyzed, and recorded. Yearly oil samples are taken and run in the EK-Oxidation-Corrosion Tester. Each year the main oil tank is drained and inspected, governor mechanism examined, oil-cooler water pressure tested, and bearing covers lifted. Every three

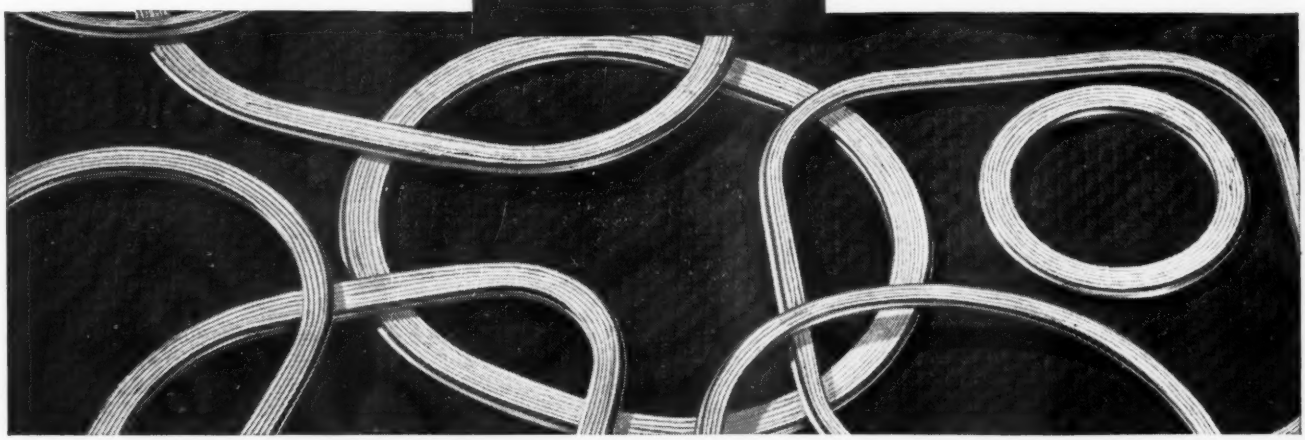


Spirotallic Style 911— a general-purpose gasket for service with both standard and special flanges. Furnished round and in irregular shapes.



Spirotallic Style 912— same as 911 equipped with a special centering device to assure accurate positioning of the gasket on raised-face type flanges.





Spirotallic Boiler Gaskets are furnished for nearly all existent handhole, tube cap and manhole covers for standard makes of boilers, economizers and superheaters.

For a perfect seal on any type flange —J-M Goetze *Spirotallic Gaskets*

IF you need a gasket with great mechanical strength *plus* resilience . . . designed to give a perfect seal under practically any service condition . . . Goetze Spirotallics will do the job for you.

Spirotallics owe their unique sealing action to their special construction consisting of a preformed corrugated metal strip cushioned with an asbestos filler *spirally wound.*

When compressed in service, their spring-like characteristics compensate for any expansion or contraction of the joined members due to temperature changes. A tight seal is made and maintained with relatively light bolting and their rugged construction frequently makes it possible to re-use them a number of times.

Spirotallics are furnished as general purpose gaskets for standard or special flanges and as boiler, manhole, and tube cap gaskets.

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years an internal inspection is made and oil cooler cleaned if necessary.

Oils in service were broadly classified as type A, a non-solvent-refined, non-additive oil; type B, a solvent-refined, non-additive oil; type C, a solvent-refined oxidation-inhibited oil.

Between 1930 and 1938 oil condition was judged by means of monthly oil tests for water, sediment, viscosity and acid number. Service life remaining in oil could not be forecast from these tests. From 1938 to 1944, interfacial tension between oil and water was taken on the monthly oil samples in addition to the above tests. This test disclosed oil changes long before any significant change in color, viscosity, or acid number was noted. A practice of changing oil when the interfacial tension dropped below eighteen resulted in a complete absence of sludging or varnishing. About 1944 changes occurred in turbine oils. Some had antirust additives so that initial interfacial tension was below operating criteria.

Rusting of oil lines occurred with both types B and C oils. No rusting was observed with type A oil although this oil gives a relatively short service life (about 20,000 hrs in turbines with 550-F steam).

Film strength of turbine oils is only of interest in gear lubrication. Some geared turbines in this plant showed gear wear when operating on type B oil. Since changing to type A oil and accepting a short service life, gears gave normal performance. *Presented at the Symposium on Service Experience with Inhibited Turbine Oils, ASTM.*

To Obtain Complete Text

Material in these briefs comes from one of these sources:

American Society of Testing Materials, Technical committee meeting, Feb. 9, 1948, Washington, D. C. Papers are identified by ASTM. Available at ASTM headquarters, 1916 Race St, Phila 3.

Amer Inst of Electrical Engineers, summer meeting, Mexico City, Mexico, June 21-25, 1948. Papers identified by AIEE and paper No. Available at Amer Inst of Electrical Engineers, 29 W 39th St, New York.

National District Heating Assn, annual meeting, St Louis, Mo., May 17-21, 1948. Papers identified by NDHA. Available in proceedings. NDHA, 827 N Euclid, Pittsburgh 6, Pa.

Midwest Power Conference, annual meeting, Chicago Apr 7-9, 1948. Papers identified by MPC. Available at Illinois Institute of Technology, 3300 Federal St, Chicago 16, Ill.

PANEL HEATING

Present Status of the Panel Heating Art, *by J S Locke, Minneapolis-Honeywell Regulator Co.* Panel heating is here to stay: A recent poll by the Curtis Publishing Co indicated 14% of their readers, who plan to build homes, also plan to use panel heating. After this opening statement on the market status of panel heating the author goes on to define panel heating and discuss methods.

These include: (1) circulating warm water through embedded pipes and coils (2) separately heated plates or panels attached to interior surfaces (3) electric heat through cables embedded in walls or floors (4) electrically-heated wallpaper and tapestry.

Present practice in this country favors floor installations. It seems least costly, especially for residences or large factory installations. To add to the known factors in this field, the American Society of Heating and Ventilating Engineers has set up a steering committee as an adjunct to its Committee on Research. Purpose is to recommend a program of research for panel heating and cooling. The remainder of the paper discusses the various subdivisions of this recommended program. *NDHA Paper.*

Steam Heating Control Practice, *by Harry C Kaysing, Hester-Bradley Co.* Prime objects of control for steam heating customers are: (1) Comfort of occupants with reasonable freedom from overheating or underheating (2) Steam economy—making each steam dollar yield a maximum toward comfort (3) Equipment relatively free of service and maintenance (4) Flexibility so the system may be changed at minimum cost to meet changing occupancy requirements. In the author's opinion orifices are essential to meet control objectives above regardless of type control sought.

Intermittent, on-off controls produce unsatisfactory comfort conditions—those referred to as "cold 70". Pulsating or cycling controls substitute for the variable "on" interval of the intermittent control a fixed time interval with a variable "on" period. As an example, a typical pulsating control turns steam on once every hour or so for a length of time depending on demand. Demand is usually held equivalent to outdoor temperature. Continuous-flow controls feed steam continuously through orifices at a pressure differential varied by an outdoor thermostat either with or without supplementary manual modification. *NDHA Paper.*

Comparative Performance of Panel and Convection Systems in Warm Air Heating Research Residence, *by S Konzo and R W Roose, University of Illinois.* A fairly wide range of environmental conditions for human body comfort can be maintained in which varying percentages of radiation, convection, evaporation and conduction are involved.

Theoretically any reduction in radiation transfer of heat from body to surrounding surfaces can be compensated for by an increase in convection transfer. A true radiant-heating system with high-temperature radiation surfaces and fairly large ventilation rates should make possible a marked reduction in ambient-air temperature. Current American practice, however, uses low-temperature panels, and negligible ventilation rates prevail. Accordingly, some doubts exist whether low-temperature panel heating exhibits markedly different characteristics from the common convection type of heating.

Test results showed surprisingly similar response and performance of both systems. The author carefully stresses that these tests apply only to the experimental residence on the campus of the University of Illinois. *MPC Paper.*

Application of Heat Balance Analysis to Industrial Plants, *by H C Carroll, Commercial Testing and Engineering Co.* A study of improvements in economy or in increased production in a steam-generating system must come from a heat balance. Such a balance reveals wastes from venting to atmosphere or dumping condensate to a sewer.

Mounting fuel costs have called the manufacturer's attention to the power plant. Recent plants are fully instrumented, closely controlled, and built around a sound heat balance.

For existing plants the heat balance shows the relative merit of replacing old equipment with new. To collect reliable data for such a balance in old plants is a rather difficult job. The author discusses several methods of arriving at information for this duty. *MPC Paper*

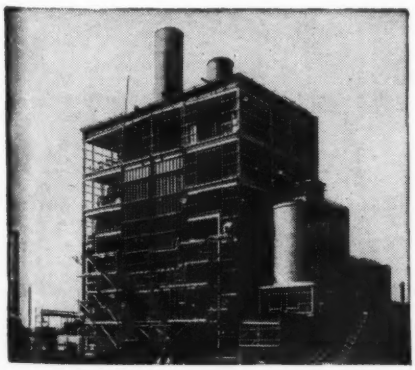
for Petroleum Refining

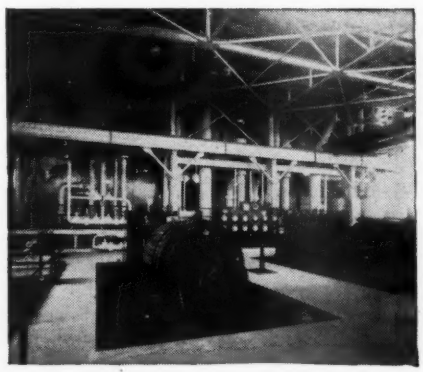
Great refineries of Standard Oil Company of Indiana convert the mid-continent's *black gold* into the myriad products and by-products which power and lubricate the planes, trains, ships, motor cars, production machinery in a large sector of industrial America.

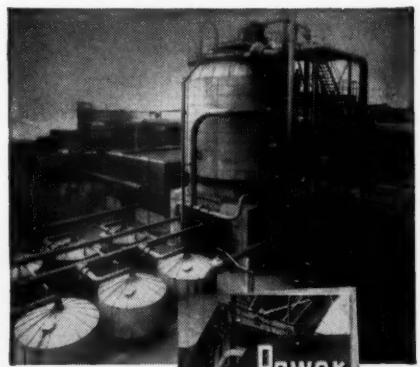
But refineries, too, require power,—electricity, steam, compressed air, liquid pumping. At its huge Wood River, Illinois, refinery Standard Oil Company planned for present and future needs with a modern plant designed to provide all the power services for petroleum processing.

Dravo Corporation Power Plant Specialists accepted complete responsibility for construction of foundations, building, and equipment installation at Wood River; Standard Oil Company Construction Engineers were relieved of details of supervision, building trades coordination, integration of separate items of equipment.

Power and Boiler Plant Specialists at Dravo Corporation have a background of experience which can be of real value to industrial executives and consulting engineers concerned with construction and equipment installations for all types of power and boiler facilities. Further details of this Dravo experience are covered in Bulletin CF-504; Power Department, 300 Penn Avenue, Pittsburgh 22, Pa.







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POWER NEWS

BUSINESS ITEMS • APPOINTMENTS • FOREIGN FIELDS
WASHINGTON NOTES • NEW DEVELOPMENTS • CONVENTIONS

Progress in Underground Gasification of Coal

► Approval of a contract between Bureau of Mines and Alabama Power Co for a second and larger cooperative experiment in underground coal gasification at Gorgas, Ala., was announced recently by James Boyd, director of the bureau. (See Power, Aug, 1947, p 138, for announcement of first experiment).

The initial joint experiment last summer showed that gases produced by burning unmined coal offer a potential source of fuel for power and raw materials for synthetic liquid fuels. If proven feasible, underground gasification offers possibilities for minimizing expensive mining and for utilizing coal veins difficult or uneconomical to mine.

FIELD TEST COST

Cost of the large-scale field test, including bureau expenditures and those of the company that are reimbursable, is estimated at $411,000 for a one-year period. Under the contract, the company will provide engineering and operating services on an actual cost basis and will contribute as a site for the experiment some 300 acres of Pratt seam coal averaging 40 in. in thickness.

Director Boyd estimated the site-preparation work would be completed this fall. At that time, he added, interested persons will be invited to inspect the underground workings before the coal bed is fired for the first experimental run.

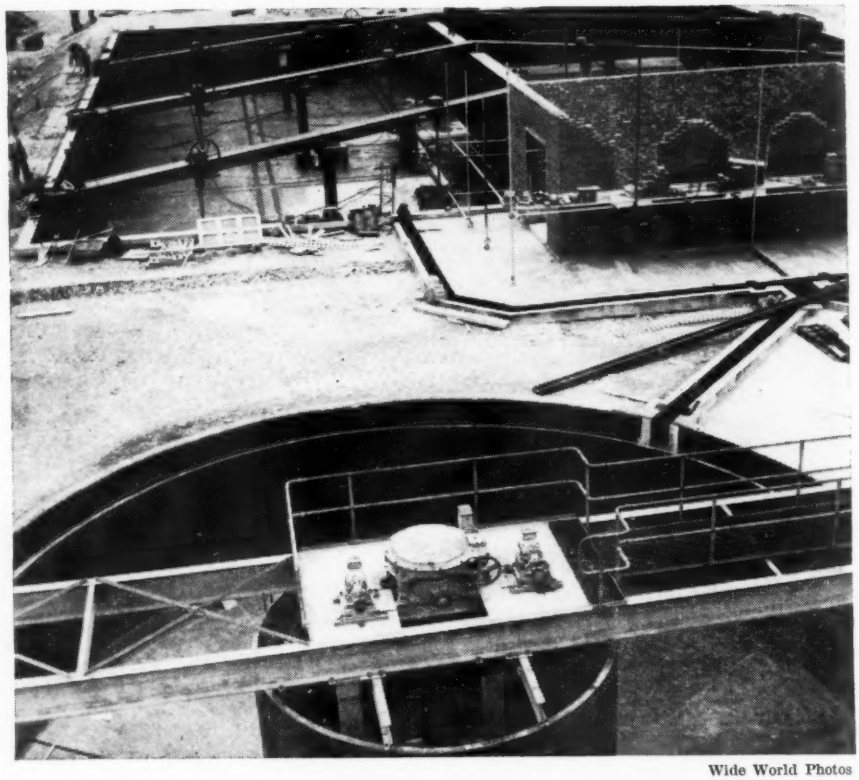
Objectives of the experiment are: (1) to determine quantity of coal that can be gasified from a given combustion zone and shape and extent of burned-out area formed (2) to determine whether fixed outlets for product gas are practicable, either at the outcrop of the coal bed or at vertical bore holes. Various designs of inlets, outlets and seals will be tested (3) to determine operating characteristics of the installation under a variety of conditions (4) to determine quality and quantity of product gas generated with an air blast under experimental conditions and, secondly, the quantity of tar and related products obtained (5) to obtain information on effect of heat on overlying strata (6) to obtain fundamental technical and economic information concerning plant sites, installations and operating processes.

EUROPEAN DEVELOPMENTS

Moscow (*McGraw-Hill World News*): Soviet fuel engineers have "in the main solved the problem of underground gasification of coal," S I Vavilov, president of U.S.S.R. Academy of Sciences, recently stated, adding that "a method for underground gasification of shale is being worked out."

Meanwhile, industrial power experts

(*Continued on page* 156)



Wide World Photos

Construction at British Atomic Research Plant

This effluent farm is being built outside British Ministry of Supply's atomic energy research establishment at Harwell, Berkshire, England. This installation will take care of a million gallons of radio-active water from the research station. The water will be rendered harmless before being returned to the Thames River

COMING EVENTS

Sept 7-9—American Society of Mechanical Engineers, fall meeting, Reed College, Portland, Ore. Ernest Hartford, executive assistant secretary, 29 W 39th St, New York 18, N. Y.

Sept 14-17—New England Water Works Assn, exhibits and technical meetings, Hotel Pennsylvania, New York, N. Y. Arthur T Clark, secretary-manager, Water and Sewage Works Mfrs Assn, 170 Broadway, New York 7, N. Y.

Oct 5-7—American Institute of Electrical Engineers, Middle Eastern district meeting, Hotel Statler, Washington, D. C. H H Henline, secretary, 33 W 39th St, New York 18, N. Y.

Oct 5-7—New England Materials Handling Exposition, Mechanics Hall, Bos-

(*Continued on page* 158)

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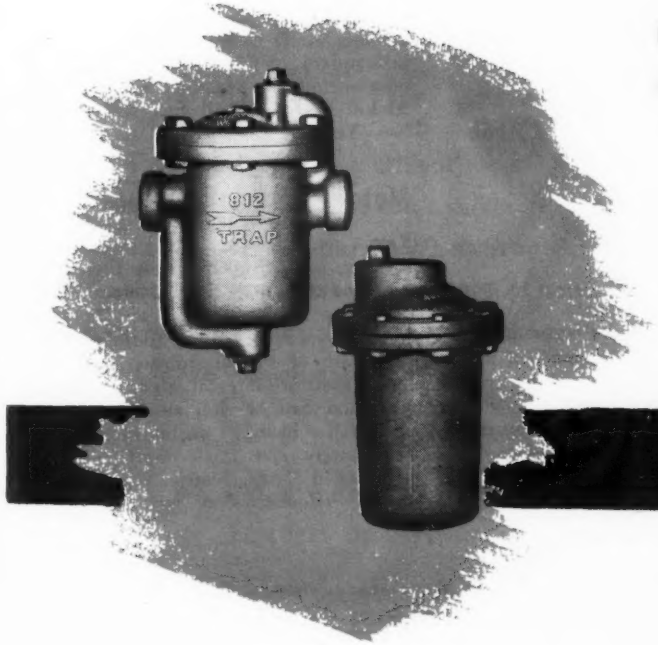

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The collar also controls height of solder, leaving an exposed length of collar without heat injury to either hose or braid. Collar also supports hose at most vulnerable point, thus eliminating need for reinforcement. **Brockway Co, Naugatuck, Conn.**

General-Purpose Floodlight E301

SUITABLE FOR SMALL-AREA LIGHTING, both Type *L-82*, rated at 300-500 watts, and Type *L-83* at 750-1000 watts, may be used for lighting small sports areas, gas stations, as well as construction projects. A tightly sealed hinged door, locked by three clamping lugs, replaces clamp ring on older types. A locking handle on the elevation adjustment eliminates need for using wrench. Both types are provided with portable base and pipe-clamp mounting. **General Electric Co, Schenectady 5, New York.**

Condensate-Return Pump E302

VERTICAL-TYPE CONDENSATION UNITS take care of 500 to 10,000 sq ft of direct radiation against pressures from 10 to 55 psi. The centrifugal pump has a fully enclosed bronze impeller, stainless-steel shaft, with slotted compression-type coupling, bronze jet tube and nozzle, and brass strainer. Receiver is made of close-grained cast iron. Unit has ball bearings, solid shaft, 3500-rpm capacitor motor, built-in thermatron with automatic reset for overload protection. It is regularly furnished for 110 to 220 v, 60 cycle, single-phase, ac. Control is by a single pole, vertical magnetic switch, fully enclosed and sealed, mounted on receiver and operated by dual float. It has no diaphragm or stuffing box. Entire pumping unit and jet can be removed from the tank for cleaning without disturbing any of the piping. **Deming Co, Salem, Ohio.**

Oil Purifier E303

HILCO OIL PURIFIERS are used for complete refining of lubricating oils in diesel engines, gas engines, automobiles, buses, trucks, and many types of industrial oil. In operation, dirty oil is piped to oil inlet on the motor pump set, and by the float control a predetermined amount is delivered to the tank. The oil is then pumped to a heater tank and mixed with Fuller's Earth; during the heating period, all solid matter and acids in the oil are absorbed. After moisture and liquid contamination are removed, heaters are shut off and compressed air is introduced. The oil is then sent through a secondary filter to an oil storage tank. **Hilliard Corp, Elmira, N. Y.**

Overrunning Clutch E304

MULTIPLE-DISK OVERRUNNING CLUTCH has drive plates, spline driven from a shaft pinion and working pressure applied automatically by the drive shaft through balls actuated by cams. Multiple-disk pressure balls transmit only working pressure, which is a comparatively small part of clutch capacity. Remainder of clutch capacity is transmitted directly to drive plates through driving splines the moment working pressure starts to build up, to give a gradual pickup. Pressure from balls and cams is transmitted to ball thrust bearing that keeps release drag low. Spring between disks insures their free running when released and exerts a light force on pressure balls during overrunning. The latter insures that the balls will start to apply the clutch as soon as driving element applies load. **Kinney Mfg Co, 3529 Washington St, Boston 30, Mass.**

Watthour Meter E305

FEATURING MAGNETIC SUSPENSION of rotating element, Type *I-50* floating-disk meter eliminates need for jewel bearings, reducing maintenance cost.

Magnetic suspension elements consist of two concentric magnets placed one within the other. Outer magnet is attached to meter frame, while inner magnet is fastened to upper end of disk shaft. Inter-action of the two magnetic fields supports the rotating system at a small downward displacement. Meter is provided with a new damping system consisting of two small *Alnico* magnets, die-cast into the frame, minimizing side thrust and the tendency to noise and vibration. **General Electric Co, Schenectady 5, N. Y.**

Shutoff Valve E306

R-S CLASS B IRON VALVE, Type *B9168*, rated at 50 psi, is for rugged hydraulic service, equipped with the patented R-S rubber spool. This spool, combined with a winch-type closure of the angular seating disk, provides positive shutoff. Valve will give bubble-tight shutoff up to 80 psi, and commercially tight shutoff at 100 psi. **R-S Products Corp, Philadelphia, Pa.**

Roofing Sheet E307

MONEL SHEET for roofing purposes has mechanical and corrosion-resistant properties as well as ease in bending, forming and seaming, states its manufacturer. Available in standard roof thicknesses, claims have been made for 100-year life. **International Nickel Co, 67 Wall St, New York 5, New York.**

Motorized Speed Reducer E308

THESE SPEED REDUCERS, in $\frac{1}{4}$ and $\frac{1}{3}$ hp capacities, are for speed ratios from 5:1 to 72:1 and from 317 rpm to 24 rpm. Output torque is from 43 in. lb to 354 in. lb. Housings are aluminum alloy and worm gears are of special bronze. Worm and motor shaft are integral, made of hardened steel and ball bearing mounted. Output-shaft roller bearings are mounted in cast-iron covers and input shaft bearing is mounted in cast-iron carrier cap. Two types

(*Continued on page* 140)

Use convenient reply cards on page 178a to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, *E*, and number, as shown on the items above.

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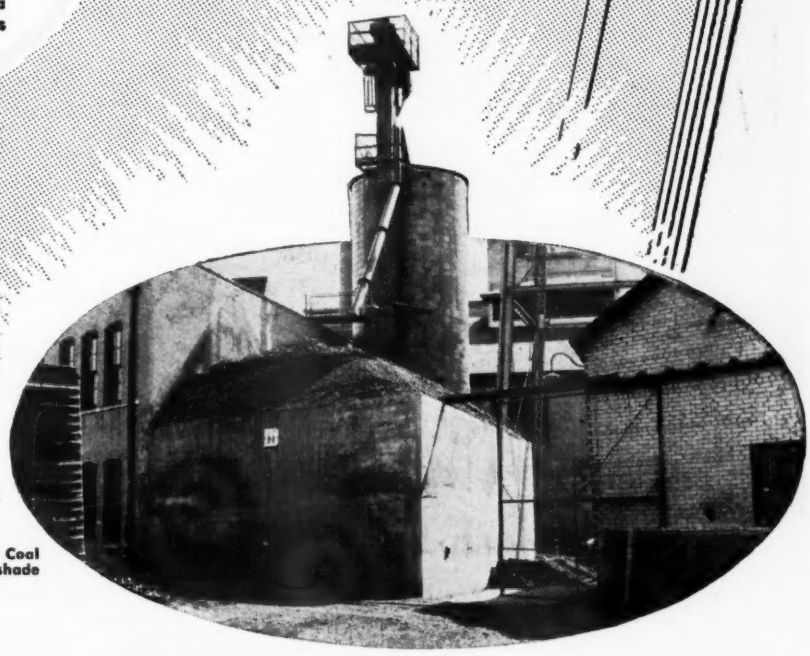

A general view of the Fairfield Coal Handling installation at Troy Sunshade Company, Troy, Ohio.

TWO PROBLEMS SOLVED at a MINIMUM of COST

When obsolescence and a critical labor shortage "team up" on coal and ash handling, costs are bound to go "sky high". When Troy Sunshade saw these costs were getting out of hand, it called in Fairfield Engineers to study the problem and make a recommendation.

What Fairfield did recommend and install makes interesting reading to everyone with a desire to hold coal and ash handling costs to a minimum. All of the facts . . . comparative costs . . . actual photos of the installation . . . installation diagrams are given in CASE STUDY 153. Send for your copy today.

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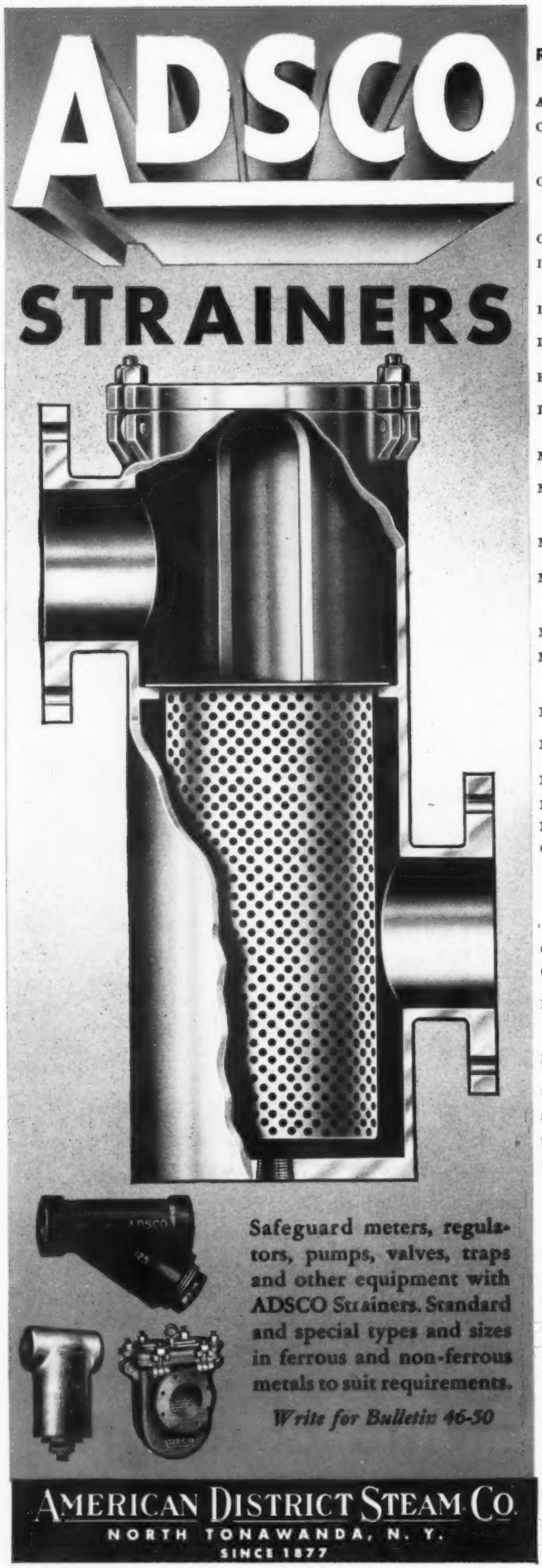
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Electronics

(*Continued from page 104*)

pared to one in which there is a high vacuum under similar conditions.

Circuit Diagrams. Fig. 9 is an elementary circuit diagram of a photoelectric tube. Here the battery's positive terminal connects to the anode and the negative terminal to the cathode as for a hot-cathode tube. The tube acts as an open switch as long as light does not impinge on the cathode. When light does fall on it, Fig. 9, electrons are released and the tube conducts. That is, current flows from the — (minus) terminal of the battery to cathode and anode through the resistor to the battery's + terminal, as arrows indicate.

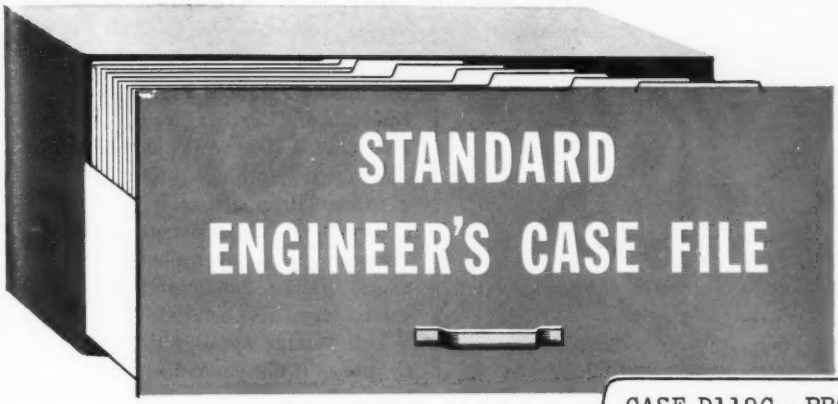
This current continues to flow, as long as light shines on the tube's cathode. Remove the light and current ceases to flow. Thus, by the simple process of letting a light beam shine on the tube's cathode or interrupting the beam, current flow in a circuit may be started or stopped.

As shown on the curves, Fig. 10 and 11. current flow through a photoelectric tube at most is only a few microamperes (millionths of an ampere). This flow is too small to do any appreciable work itself. But the tube can be placed in a circuit with a hot-cathode tube, Fig. 12, and its small current amplified to any desired value. For example, the hot-cathode tube may operate a relay that in turn actuates a contactor in another circuit.

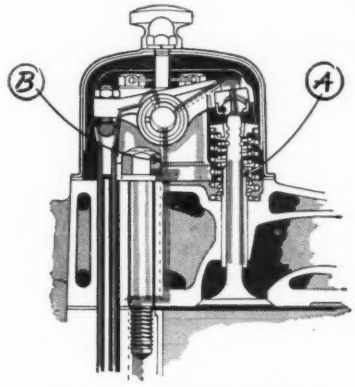
With the photoelectric tube inactive, Fig. 12, current flows from battery *A* through the cathode to heat it and release electrons. But minus potential of battery *C* on the grid is high enough to prevent the flow of current through the tube.

Grid Potential. Right here we should answer the question of how we know there is a minus potential on the grid. Simplest answer is that the minus terminal of battery *C* connects to the grid. Under this condition current tends to flow from the battery *C* — terminal, through resistance *R*, from grid to cathode to battery's + terminal.

But this cannot occur because the grid is also acting as a cathode and is cold under normal conditions; current cannot flow from a cold to a hot cathode. Voltage of *C* battery, however, as applied between grid and cathode, tends to cause current to flow from former to latter. Even if it cannot cause current to flow, if the voltage is high enough it can prevent current flow from



CASE D119C--PROVIDING GOOD VALVE ACTION IN DIESEL ENGINES.



DIESEL ENGINE VALVE ASSEMBLY

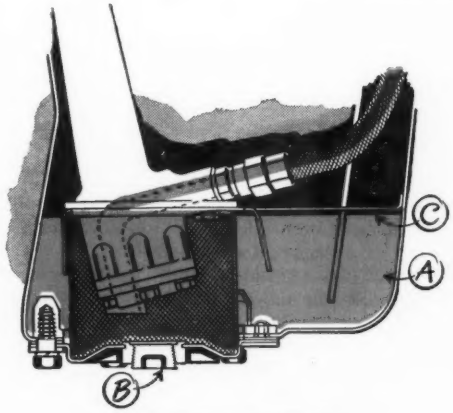
When Diesel engines, operating in tough heavy-duty service, were lubricated with compounded RPM DELO Diesel Engine Lubricating Oil, valve stems and guides did not gum up. They received thorough lubrication at all times and wear was negligible. RPM DELO Oil is recommended for all types of Diesels. Comes in several viscosity grades to meet all conditions.

A. Specially selected oxidation-resistant base stocks and special compounds prevent formation of gum and lacquer . . . oil film adheres to hot or cold metal surfaces.

B. Detergent compound keeps oil passages clean and open . . . and allows free flow of adequate supply of lubricant to wear points.

RPM DELO Diesel Engine Lubricating Oil is non-corrosive to all bearing metals. This quality and high stability assure sound bearings in Diesels for long service periods.

CASE D119D--KEEPING PARTS CLEAN AND REMOVING CONTAMINANTS FROM DIESEL ENGINES.



DIESEL ENGINE CRANKCASE

Cylinder walls, pistons, bearings and other parts of Diesel engines in heavy-duty service remained free of lacquer, and all contaminants flowed out with drainings when RPM DELO Diesel Engine Lubricating Oil was used.

A. A special compound in RPM DELO Oil loosens and removes lacquer and other deposits from parts and oil passages . . . and they stay harmlessly dispersed in the oil.

B. The finely dispersed contaminants, including condensate and dust, flow out freely when crankcases are drained.

C. Another compound in RPM DELO Oil prevents foaming —allows accurate measurement of oil levels and delivery of sufficient lubricant by oil pumps.

The engine-cleaning qualities of RPM DELO Oil help reduce wear on parts and prolong greatly the operating periods between engine overhauls.

For additional information and the name of your nearest Distributor, write

STANDARD OIL COMPANY OF CALIFORNIA

225 Bush Street, San Francisco 20, California

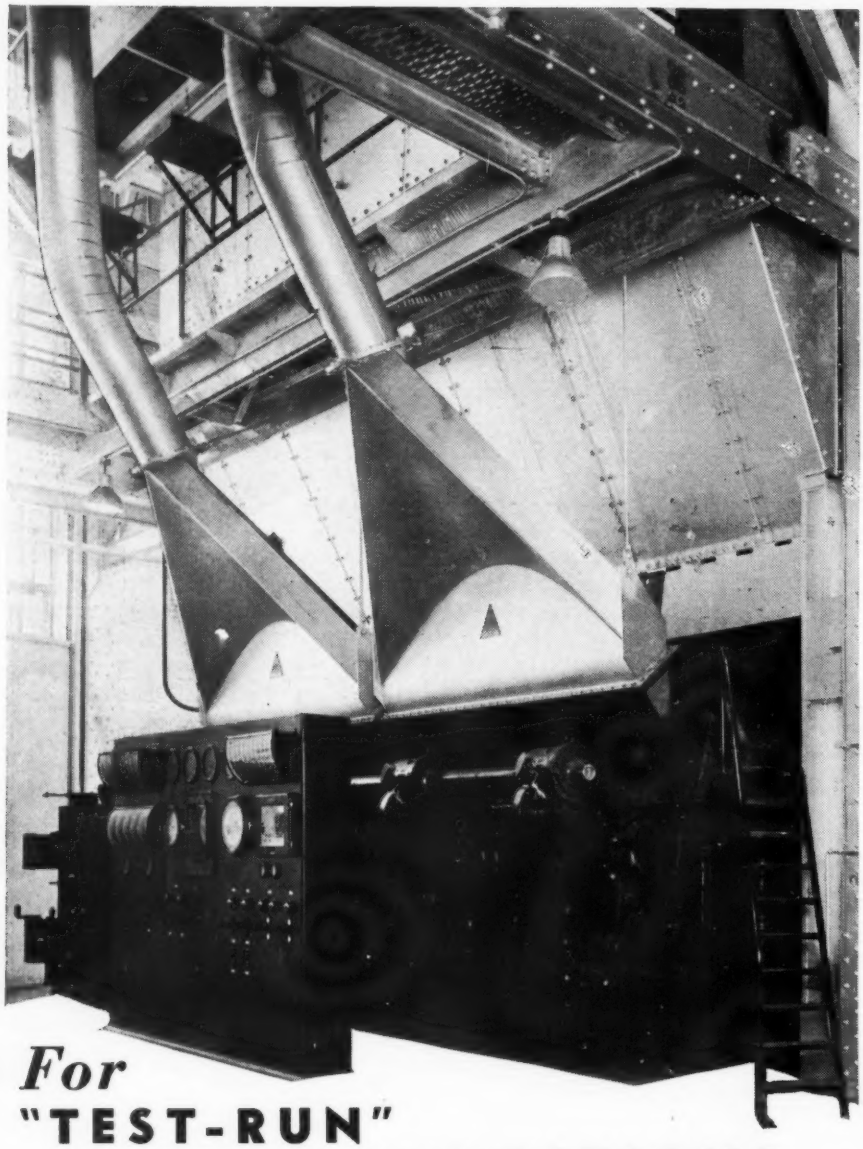
The California Oil Company
Barber, New Jersey

The California Company
17th and Stout Streets, Denver 1, Colo.

Standard Oil Company of Texas
El Paso, Texas

DIESEL ENGINE RPM DELO LUBRICATING OIL

Trademarks Reg. U. S. Pat. Office



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FIRING CONDITIONS
ALL OF THE TIME—

Equip your stokers with CONICAL Non-Segregating Coal Distributors and obtain these desirable results immediately:

—Elimination of coal segregation
—Reduced stoker and arch maintenance
—More uniform fires for improved boiler performance
—No coal dust nuisance. (ALL CONICAL Distributors are dust-tight.)

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ENGINEERING CO.

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Coal Valves and Coal Scales

hot cathode to anode, which it is assumed to do here.

When light shines on the photoelectric tube's cathode, Fig. 13, the tube conducts and current flows from battery *D* through resistor *R*, as indicated. Current flowing through resistor *R* causes a voltage drop across it equal to the current times the resistance. If we assume a 5-megohm resistor (5,000,000 ohms) and a 2-microampere current, voltage drop across resistor *R* is 10 v.

This voltage opposes that of battery *C*, just as if the photoelectric tube were eliminated and resistor *R* replaced by a 10-v battery. This battery connected in circuit to give the polarity shown on *R* would oppose grid battery *C* and reduce potential on the grid by an equal amount. The tube can now conduct as indicated for battery *B* to energize the relay coil and cause it to close its contact. Interrupting the light beam on the photoelectric-tube cathode restores the conditions in Fig. 12, and the relay opens.

This is one of many ways photoelectric tubes control circuits. Others will be explained later.

Alabama Power Co expects to install a new 60,000-kw unit in the Gorgas steam plant, according to President Thomas W Martin. This unit and the 40,000-kw unit, to be installed in the Mobile district, have been contracted for earlier delivery. These two units bring to 242,000 kw the total capacity that the company now has on order. Martin pointed out that the new capacity to be added to the company system means a total investment of $50,000,000, including transmission lines, substations and other facilities.

Aluminum Co of America plans construction of an aluminum-producing plant at Point Comfort, near Port Lavaca, Texas, and construction of an 80,000-kw capacity electric-generating plant. The new plant, which will use natural gas for fuel, marks the first peacetime use by Alcoa of electricity generated by other means than water power. I W Wilson, vice-president in charge of operations, and Thomas D Jolly, vice-president and chief engineer, say it will require about two years to complete the plant.

Canadian General Electric Co has been awarded a contract by B. C. Power Commission for fabrication and installation of two 12,500-kva generators at the new Whatshan-Arrow Lakes hydro project. Contract price of $348,535 includes spare parts, air coolers and certified factory tests. First unit will be delivered in 18 months, the second in 19 months. H G Acres & Co has been retained as general consultant. The generators will be 15,000-hp 720-rpm reaction wheels operating under 690-ft head. The plant is being designed for four units, only two of which are to be installed in the initial development.

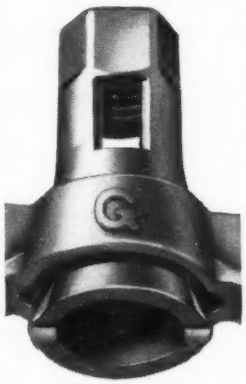
THERE'S A **GRINNELL** HANGER FOR EVERY PIPING REQUIREMENT

Hanging Pipe? Do it Right!

GRINNELL ADJUSTABLE SWIVEL PIPE RING

(Split Ring Type)

- Hinging of ring is off-center. This provides sufficient seating to hold pipe before closing ring. Wedge-type pin is loosely but inseparably cast into the hinged section for fastening after pipe is in place.
- To obtain proper adjustment, swivel shank can be turned easily by hand when the weight of the pipe is temporarily taken off the ring.
- When weight is returned, patented swivel shank locks automatically, preventing change of adjustment due to vibration. Wire retaining ring prevents separation of the swivel shank from the pipe ring or yoke . . . makes assembly a single unit.
- 12 sizes have load range of 80 lbs. for ¾" size to 1510 lbs. for 8" size. May be used in connection with practically any building attachment.



Enlarged section showing locking feature.

SAVE MONEY ON ASSEMBLY. Cut installation time, get better, stronger installations, with Grinnell Engineered Pipe Hangers.

NO SAG . . . NO WATER TRAP. Grinnell Hangers permit adjustment after pipe is installed. This makes it possible to prevent sagging pipe and water traps, and assures positive drainage for the entire system.

FOR EVERY INSTALLATION. There is a stock Grinnell Hanger for every need from simple water pipe to high pressure, high temperature steam line. Where necessary there is a hanger to compensate for thermal movement.

Don't waste time or take chances on inadequate pipe hangers and supports. All Grinnell hangers comply with piping code requirements.

GRINNELL COMPANY, INC.
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GRINNELL

WHENEVER **PIPING** IS INVOLVED

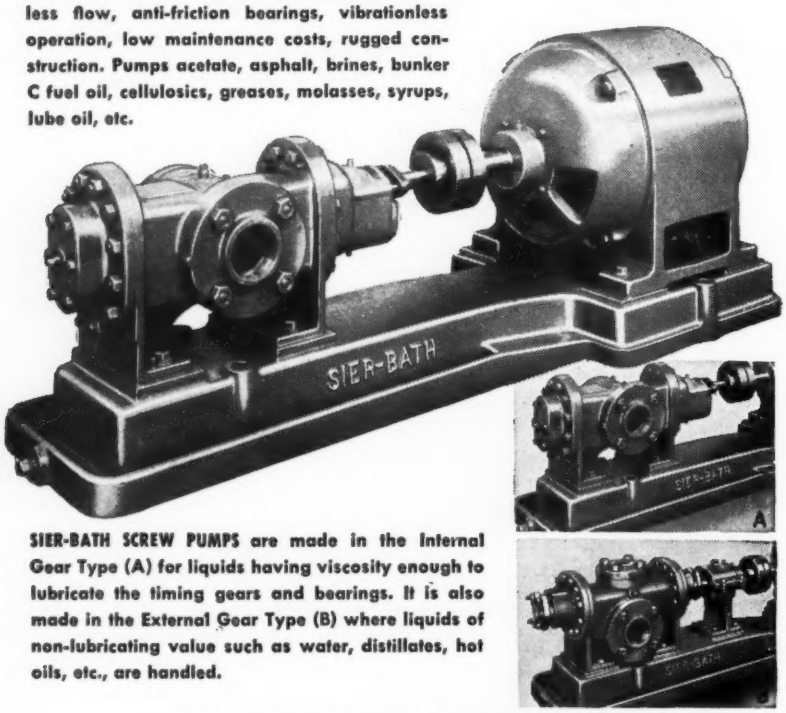
Viscosity means nothing to SIER-BATH SCREW PUMPS

IF you handle fluids so viscous that they are likely to "gum up the works"—it is time for you to look at Sier-Bath Screw Pumps. Nothing beats the thrust of the screw—whether it be the propeller that drives an enormous ship, or the screws in powerful Sier-Bath Screw Pumps.

Having no reciprocating parts, the flow of liquid is continuous . . . no pulsation or fluctuation of pressure, no vibration, no wear-and-tear on pipe joints and connections. Maintenance is reduced to a minimum.

Sier-Bath Screw Pumps can be obtained either in the horizontal model or, where space limitations require, in the vertical model. Send for Bulletin S-3 for complete information.

SIER-BATH SCREW PUMP ADVANTAGES: Pulseless flow, anti-friction bearings, vibrationless operation, low maintenance costs, rugged construction. Pumps acetate, asphalt, brines, bunker C fuel oil, cellulosics, greases, molasses, syrups, lube oil, etc.



A

SIER-BATH SCREW PUMPS are made in the Internal Gear Type (A) for liquids having viscosity enough to lubricate the timing gears and bearings. It is also made in the External Gear Type (B) where liquids of non-lubricating value such as water, distillates, hot oils, etc., are handled.

ALSO MAKERS OF SIER-BATH PRECISION GEARS

FOUNDED 1905 **MEMBER A. G. M. A.**

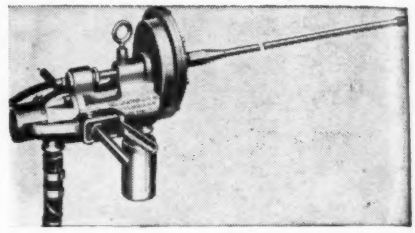
Sier-Bath GEAR and PUMP CO., Inc.

9254 HUDSON BOULEVARD • NORTH BERGEN, NEW JERSEY

New Equipment

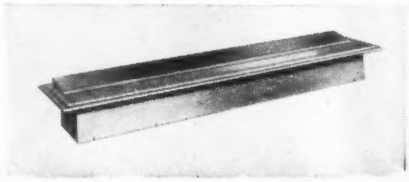
(*Continued from page* 134)

of general-purpose motors are available: capacitor type in 115 v and 230 v, also 3-phase in 220 and 440 v. Dripproof construction with cast-in terminal box permits easy wiring. **Dept 60, Ohio Gear Co, 1400 E 179 St, Cleveland, Ohio.**



Tube Cleaner E 309

GEARED, AIR OR STEAM-MOTOR-DRIVEN tube cleaner removes scale in heat exchanger and condenser tubes of $\frac{3}{8}$ to $2\frac{1}{2}$ in. ID. Three models of outside mounted cleaners are available. No. *CC*-325 operates up to a maximum of 800 rpm with a variety of drills. It has a valve on the handle to give positive control and a muffler to reduce noise. **Airetool Mfg Co, 342 S Center St, Springfield, Ohio.**



Flushing Oil for Turbines E 310

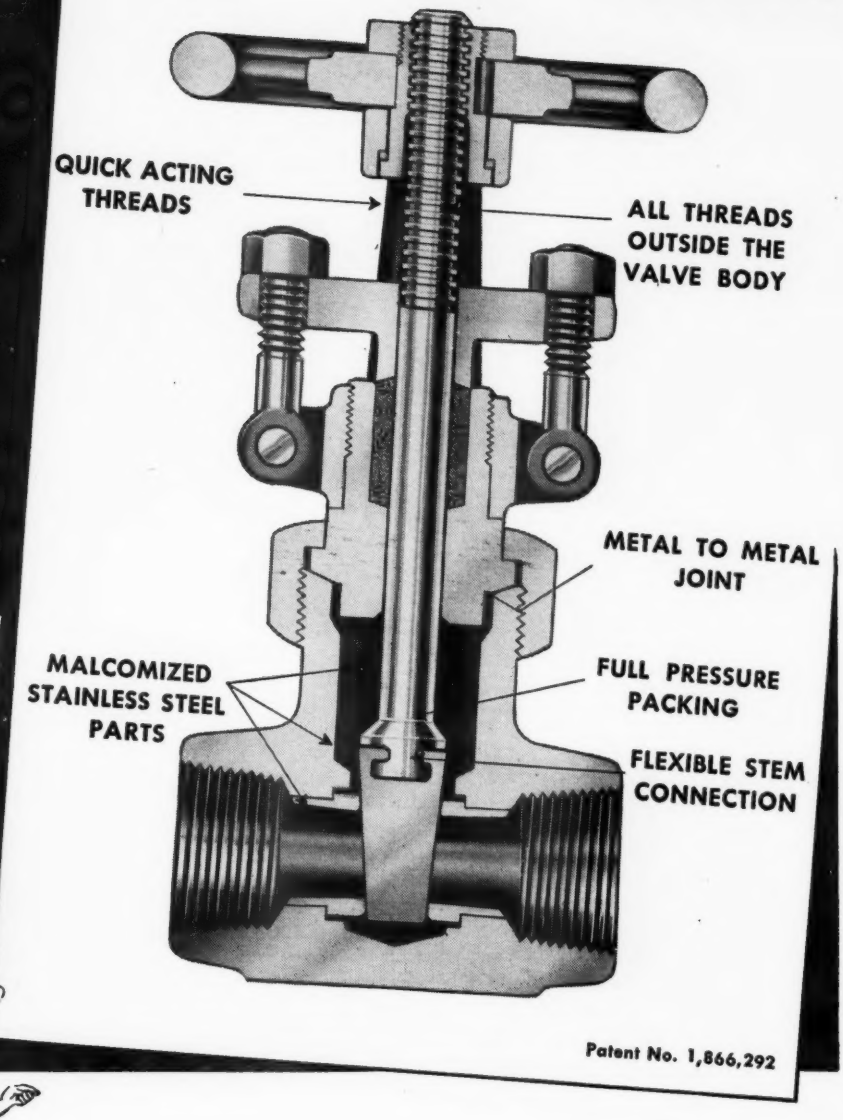
SPECIFICALLY ENGINEERED for cleaning the oil circulating system of steam turbines, this new product effectively removes abrasive contaminants, grease-type slushing compounds, sludges and organic acids. It contains an effective rust inhibitor for protecting clean metal surfaces. Named *Gulf Turbine Flushing Oil*, it is in itself a light viscosity lubricant and not a non-lubricating solvent; hence, it does not affect lubricating efficiency of turbine oils. **Gulf Oil Corp, 3800 Gulf Bldg, Pittsburgh 30, Pa.**

Heavy-Duty Magnet E 311

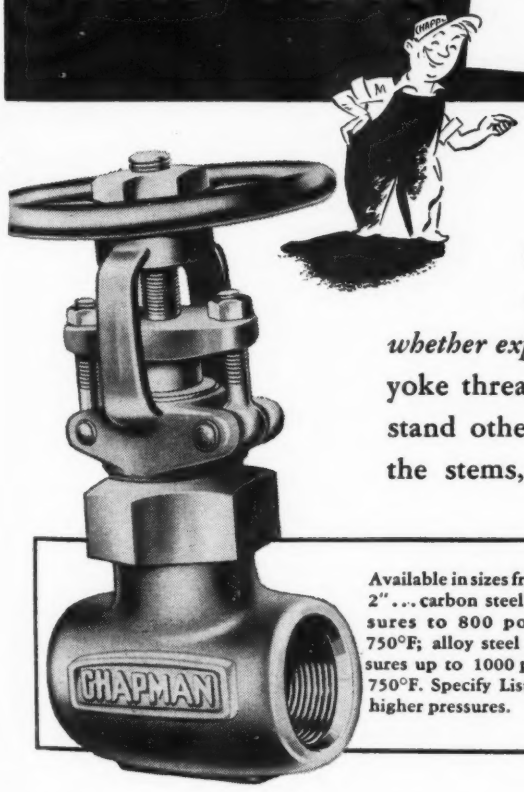
PERMANENT-MAGNETIC SEPARATOR is adaptable for general use in the power field. *Alnico* castings provide a deep, constant, uniform magnetic field that removes tramp iron from heavy free-flowing material flows. The effective cleaning range varies depending upon size of material and operating conditions involved. Special face plates are built of abrasive-resistant steel and are furnished in either flat or stepped poleface. The face plate required depends upon application and size of tramp iron to be removed.

Two models are available: One is for

Yoke Threads are Safe from RUST and CORROSION if it's a CHAPMAN LIST 960 Gate Valve



Patent No. 1,866,292



Available in sizes from ¼" to 2"... carbon steel for pressures to 800 pounds at 750°F; alloy steel for pressures up to 1000 pounds at 750°F. Specify List 990 for higher pressures.

The bonnet of the Chapman List 960 has a flanged forged-steel packing gland that eliminates exposed threading. Whatever the location of this valve . . . *whether exposed to rain and snow, or inside your plant* . . . the critical yoke threads are protected against rust and corrosion. To withstand other abuse, the body and yoke are made of forged steel; the stems, plugs and seat rings of Malcomized stainless steel. Quick acting threads open and close easily . . . will not stick or freeze.

The CHAPMAN Valve Manufacturing Company
INDIAN ORCHARD, MASSACHUSETTS

How to put faraway suppliers close to "home"

What if suppliers *are* thousands of miles away? When you specify Air Express, you cut down delivery of equipment, supplies and finished products to a matter of hours. Air Express is the *fastest service* there is. Remember—large inventories are expensive. You can keep them low by getting what you need in hours.

Air Express goes on every flight of the Scheduled Airlines—places the most distant suppliers only hours away. And you get fast pick-up and delivery service at no extra cost. Rates are *low*. Use Air Express regularly and keep things hustling.

Specify Air Express-World's Fastest Shipping Service

- Low rates—special pick-up and delivery in principal U. S. towns and cities at no extra cost.
- Moves on all flights of all Scheduled Airlines.
- Air-rail between 22,000 off-airline offices.

True case history: Sacramento, California, dairy regularly gets replacement parts and equipment by Air Express. Keeps inventory low—gets things in hours. Typical shipment: 32 lbs. of parts picked up in Detroit 7 P.M., in use at Sacramento next afternoon. 2039 miles, Air Express charge $19.65. Any distance similarly inexpensive. Phone Air Express Division, Railway Express Agency, for fast shipping action.

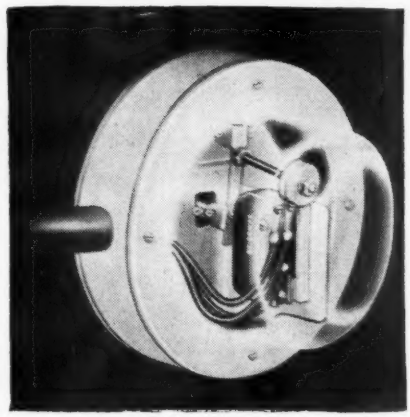
AIR EXPRESS
GETS THERE FIRST

Rates include pick-up and delivery door to door in all principal towns and cities

AIR EXPRESS, A SERVICE OF RAILWAY EXPRESS AGENCY AND THE
SCHEDULED AIRLINES OF THE U.S.

stationary installation in open chutes; while the other, equipped with hinges and latches is recommended for closed chutes. Hinges permit the unit to be swung down for easy cleaning. Both models are insulated to prevent magnetic leakage, which allows direct installation on steel. The magnet protects crushing and grinding machinery and, in many instances, prevents coal-dust explosions.

These units are normally installed at the discharge end of car unloaders and coal conveyors; in short discharge chutes following magnetic head pulleys; in downcomer spouts leading to stokers, pulverizers, or hammermills and directly on the hoppers of coal pulverizers. Magnets are available in sizes ranging from 6 in. up and can be built in any size to give magnetic protection the full width of conveying lines. **Eriez Mfg Co, 3144 E 12th St, Erie, Pa.**



Bin Level Indicator E312

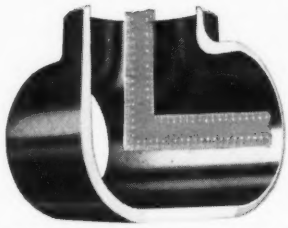
BANTAM BIN-DICATOR, $5\frac{3}{4}$-in. in diameter, is designed for small hoppers, spouts, chutes, conveyors, and other applications where the standard unit cannot be used. It has diaphragm-operated switches in sealed housings that mount on the outside of bins, hoppers or screw conveyors, and signal changes in material levels. They will automatically start and stop filling and emptying equipment as level of material reaches designated limits. It serves successfully on bulk materials weighing 2 to 350 lb per cu ft. A special arrangement of the microswitch is used on units to operate on the light materials. It is used to stop machinery when feed chutes or elevator boots become clogged with material. Special models are available for hazardous locations, and for internal mounting inside thick-walled or multiple compartment bins. **Bin-Dicator Co, Detroit 15, Mich.**

Forged Steel Valves E313

ENTIRE LINE of 600-psi forged steel valves are available in gate, globe, angle and check design with various types of trim. They are available in screwed, flanged and socket weld type. End flanges on the flanged valves are machined 600 psi ASA Standard B-16-E, and have a large male face $\frac{1}{4}$ in. high with a serrated finish. When required, valves can be furnished with ring joints, small male, large or small female, or large

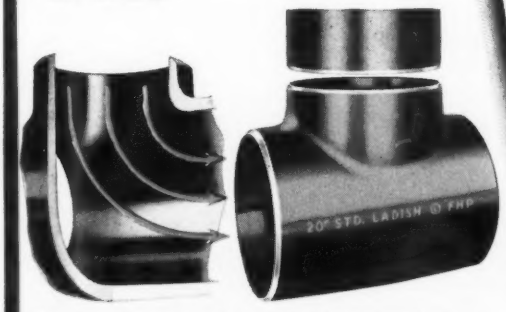
(*Continued on page* 146)

Give Your Piping the EXTRA PROTECTION of LADISH Full Branch SEAMLESS WELDING TEES



All Ladish Tee center-to-end dimensions of the run and branch are identical—providing full-length-branch outlets.

Scientific metal distribution—achieved through taper design—assures maximum strength in every cross section and equalizes stress over the entire fitting.



Long, sweeping crotch radius reduces pressure loss and minimizes resistance to flow.

Full length branch provides accessibility for welding.

Another example of engineering leadership . . . all Ladish Seamless Welding Tees—¾" through 20"—provide the greater safety and ease of installation resulting from full-length-branch outlets. This advanced design affords extra protection by keeping high welding heats safely away from vital crotch areas. The proven strength advantages of Ladish tapered construction are present in the branch as well as the run.

A COMPLETE LINE PRODUCED UNDER ONE ROOF
... ONE RESPONSIBILITY

LADISH CO.

CUDAHY, WISCONSIN
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DISTRICT OFFICES: New York • Buffalo • Pittsburgh • Philadelphia
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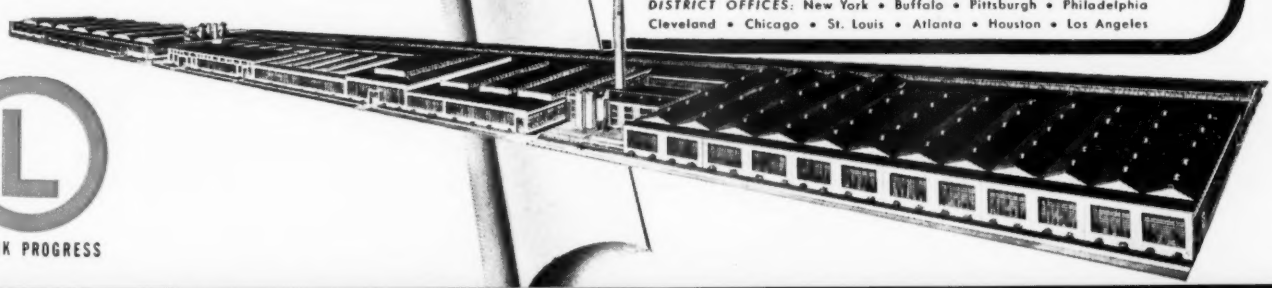
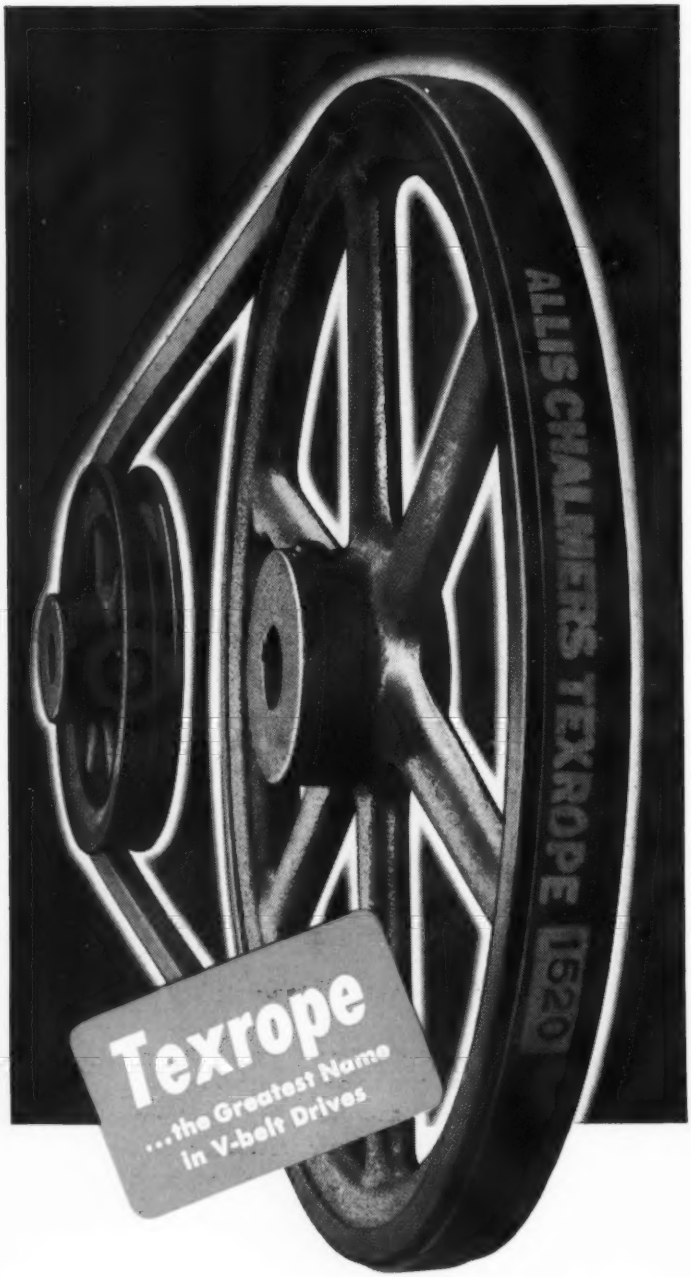


TO MARK PROGRESS

TEXROPE F/HP Drives



- **"ENGINEERED" FOR INDUSTRY!**
- **AVAILABLE NOW!**
- **CARRY THE NAME "TEXROPE"... AND OVER 25 YEARS OF EXPERIENCE!**

IF YOU'RE IN THE MARKET for fractional horsepower V-belt drives, here are good reasons for investing in TEXROPE — the greatest name in V-belt Drives. 1) They're "engineered" — selected and applied to suit the exact characteristics of your drive. 2) They're in stock at Authorized A-C Dealers or available promptly through A-C District Offices, and 3) They're backed by the greatest collection of V-belt drive experience and facilities of any company in this business.

TEX-IRON F/HP SHEAVES

High density cast iron. Accurately bored for easy fit with tight shaft grip. Precision grooved for non-slip power and longer belt life. Carefully balanced for vibrationless operation at all speeds.

TEXROPE F/HP V-BELTS

Best known name in V-belts. Carry full rated load with plenty of overload and shock load capacity. Molded to fit sheave groove and grip tightly without excess wear or wasted power. An ideal teammate for Tex-Iron sheaves. Highly efficient on present sheaves, too.

The complete range of Tex-Iron sheaves from 2 to 15 inches PD and Texrope V-belts to match are now available from your dealer's stock. Call him today. Texrope, Tex-Iron, Super 7, Texsteel, Magic Grip and Vari-Pitch are Allis-Chalmers Trademarks. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

A 2510

A Complete Range of Products		
Super-7 V-belts	5 types . . . sizes to suit every power transmission job	
Texsteel, Texdrive, Magic-Grip	Sheaves in a full range of sizes and grooves	
Vari-Pitch Sheaves	Exact varictions in speed — Stationary or Motion control	
Speed Changers	Speed variations up to 375% at the turn of a crank	

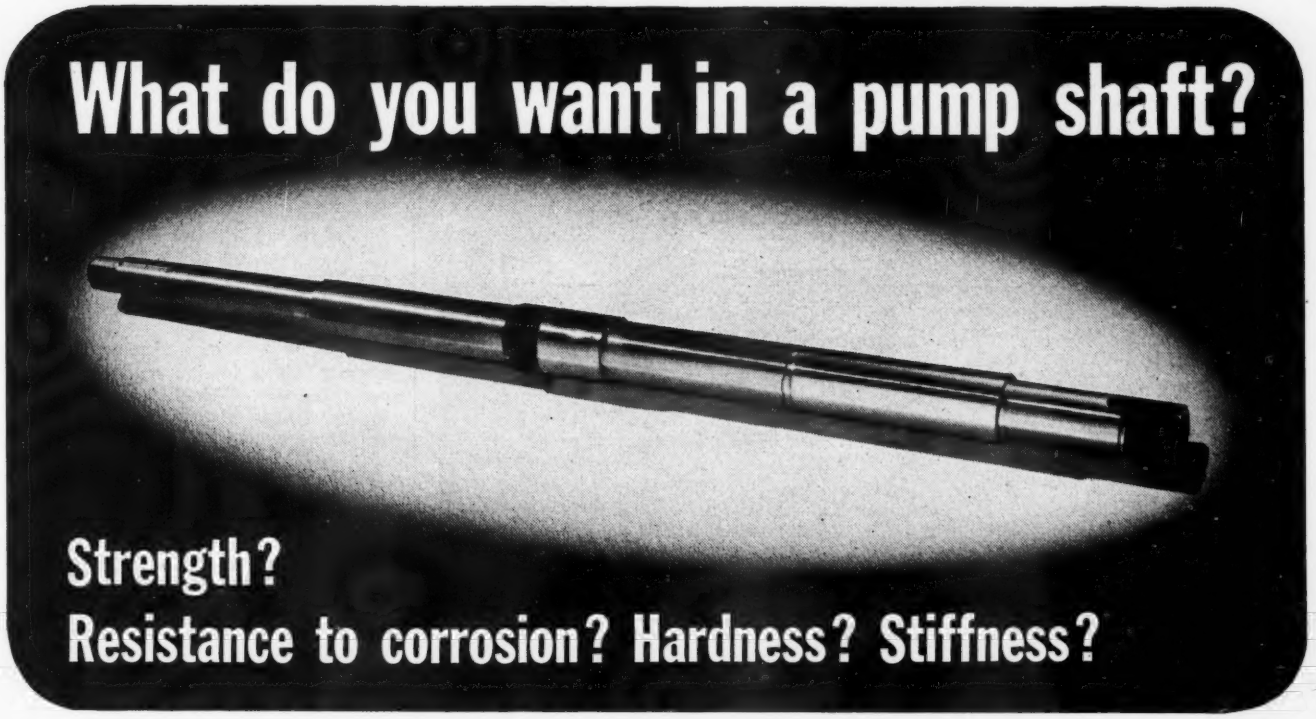
SEND TODAY for Allis-Chalmers 44 page book No. 2086249A describing Texrope F/HP V-belt drives — the Fractional Horsepower Drive that's "Engineered" for Industry. Result of years of experience in engineering FHP V-belt drives. Shows you simple, accurate way to select FHP sheaves and belts. Every FHP drive user should have a copy.

Texrope Super-7 V-belts result from the cooperative research of Allis-Chalmers and B. F. Goodrich; and are sold only by A-C dealers and offices.

ALLIS-CHALMERS

Originators of the Multiple V-belt Drive for Industry

What do you want in a pump shaft?



Strength?
Resistance to corrosion? Hardness? Stiffness?

When you specify *Monel* for pump shafts, you get the combination of qualities needed to combat severe service conditions of wear, stress, vibration, corrosion, and heat. *Monel* insures against frequent, costly replacements; cuts maintenance overhead.

Remember... *Monel* has *all* these features:

- **High resistance to corrosion, corrosion-fatigue, and stress-accelerated corrosion.**
- **Exceptional hardness, which means less wear at bearings and journals.**
- **High resistance to fatigue caused by stress, vibration, and pulsation.**
- **Strength equal to that of steel.**
- **And if you need special properties, there is *"R" Monel* for high-speed production machining; *"K" Monel* that is heat-treatable to tensile strength higher than 150,000 psi; *"KR" Monel* that is both free-machining and heat-treatable.**

For help in solving metal selection problems, send for your INCO NICKEL ALLOYS SELECTOR. This handy slide-rule-type chart tells you at a glance which of the versatile Inco Nickel Alloys will best serve your requirements.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

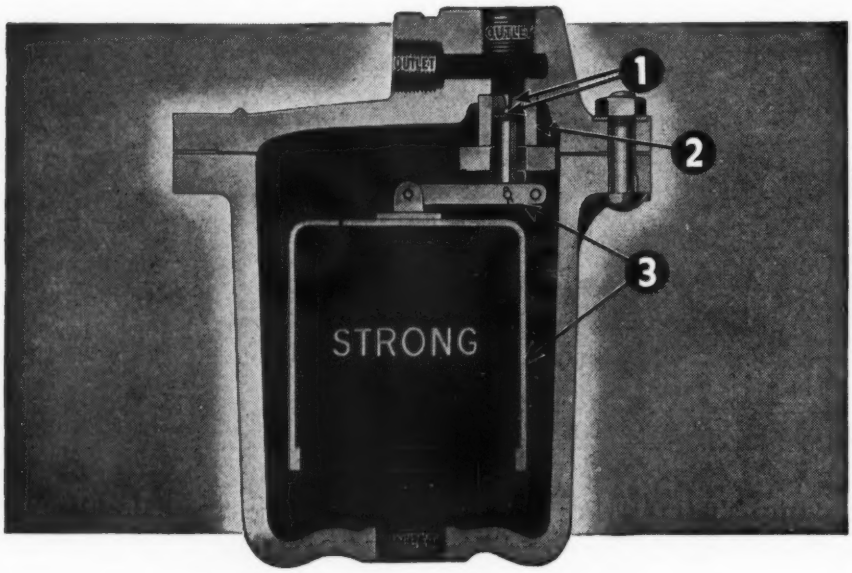
MONEL
solved these difficult problems—

Case 1. In a large metropolitan power plant, the mild steel shaft of a huge circulating pump failed repeatedly because of corrosion-fatigue. Several other metals were tried without success. Then engineers called for "K" Monel. *The result was the world's largest high Nickel alloy pump shaft*—13'x9" dia.!

Case 2. A pump manufacturer had difficulty making long, thin shafts for multi-stage high pressure pumps. Stresses set up during machining caused the shafts to deform and fail in service. Heat-treatable *"K" Monel* was tried—and proved to be the solution to this problem, too.

EMBLEM OF SERVICE
NICKEL INCO ALLOYS MONEL* • "K"* MONEL • "S"* MONEL • "R"* MONEL • "KR"* MONEL • INCONEL* • NICKEL • "L"* NICKEL • "Z"* NICKEL
*Reg. U.S. Pat. Off.

3 Reasons STRONG* Traps are easy to maintain!



Look for these three STRONG low-maintenance features in the STRONG 80 Series Inverted Bucket Trap:

1. **Anum-Metl Valve and Seat—guaranteed leakproof for one year;**
2. **Bolted-in seat design—insures tight seal, easy servicing;**
3. **Stainless steel bucket and trim.**

Compare these features with other traps!

STRONG 80 Series Trap sizes ½" to 2½", pressures to 250 lbs., temperature to 500° F. (forged steel for higher pressures).

Dual outlet simplifies piping, bottom inlet keeps trap cleaner. Years of trouble-free operation assured by super-STRONG construction.

Catalog No. 67 describes inverted, open bucket and other types of STRONG traps. Write today.

*Trade Mark Reg. U. S. Pat. Off.

STRONG, CARLISLE & HAMMOND COMPANY
1392 West 3rd Street
Cleveland 13, Ohio

ANUM-METL Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES

Reducing Valve | 70 Series Trap | Strainer

STRONG

or small tongue and groove facing. Flanges are forged as an integral part of the body and all bonnets are forged in one piece.

In the globe, angle, and lift check valves, the seats are threaded and screwed into the bodies and can be removed and replaced with the simplest of tools. All disks are of the swivel or loose type and are fastened to the stem with a disk stem ring. Stuffing boxes are deep and large, providing plenty of space for packing. Valves can be packed under pressure. All bonnet studs and nuts are of heat-treated material. Ample clearance is provided under the disk to allow for wear in service, and to provide a space where foreign material can drop out of the way. **Ohio Injector Co, Wadsworth, Ohio**

Trough Conveyor E314

NEW CONVEYOR is a positive-action roller-bearing, eccentric oscillating trough-feeder type, motor driven through a fluid coupling connecting to the machine's eccentric shaft by a chain or V-belt. Conveyor is available in standard trough widths of 12 to 48 in., in single lengths up to 100 ft, to suit required capacity and character of material handled. For longer runs two or more units may be arranged in series, one discharging into the other. Besides handling material, the conveyor may also serve as a cooler, drier or conditioning unit when jacketed, louvered or otherwise constructed for the intended service. Trough is either pan type or constructed with channel-steel sides. Standard troughs are leakproof and may be supplied with dust-tight covers or constructed for air- and gas-tight movement of material. Conveyor trough can also be fabricated of corrosion- and heat-resisting material. **Link-Belt Co, 307 N Michigan Ave, Chicago 1, Ill.**

Plug-In Panelboard E315

PLUG-IN FEATURE of this panelboard permits easy and quick removal for installation of circuit-breaker units, giving flexibility in circuit ratings as well as providing for circuit additions. Each circuit breaker mounts on cylindrical, silver surface busbars by positive-pressure contact jaws.

The 3-phase, 4-wire panelboard has all branch circuits identified by letters *A*, *B* or *C* for phase identification.

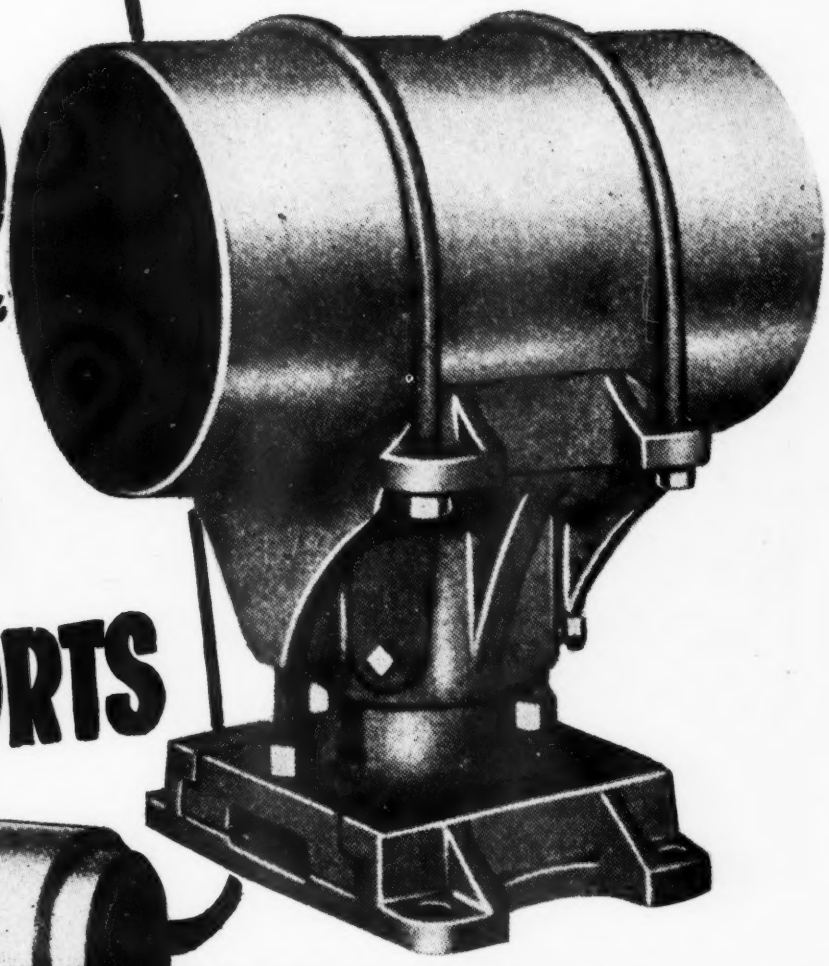
Each breaker has a combined thermal-magnetic trip, insuring adequate time lag for motor starting and tungsten lamp in-rush current. *NMO* panelboards of similar design are available for both single-phase, 3-phase 4-wire service, as well as 3-wire supply, for 15 ,20, 30, 40 and 50 amp branch circuits. **Square D Co, 6060 Rivard St, Detroit 11, Mich.**

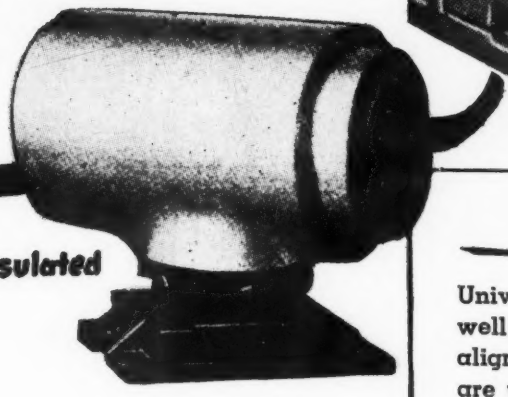
Combustion Regulators E316

DIAPHRAGM-OPERATED REGULATOR gives simple design, states the manufacturer, by working through electrical contacts to energize motors of opposite rotation.

The regulator is actually three instruments; (1) a master regulator operating from steam header pressure and actuating fuel feed (2) an air flow regulator under control of master regulator and a draft differential across the boiler working a

NAVCO "Universal" PIPE SUPPORTS





Vertical adjustment up to 2½ inches can be made.

Support may be turned to any angle of 360°

Will take care of 8 inches of travel.

Features

Universal Pipe Supports hold the pipe down as well as up. They prevent pipe from getting out of alignment, which is usual when Roller Supports are used.

They permit control of expansion movement and insure the desired free action of Slip Expansion Joints so essential in tunnel and duct work.

Expansion movement of pipe will not disturb the insulation.

Made in Cast Iron or Steel and provided with forced lubrication for lines exposed to the weather.

NAVCO

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

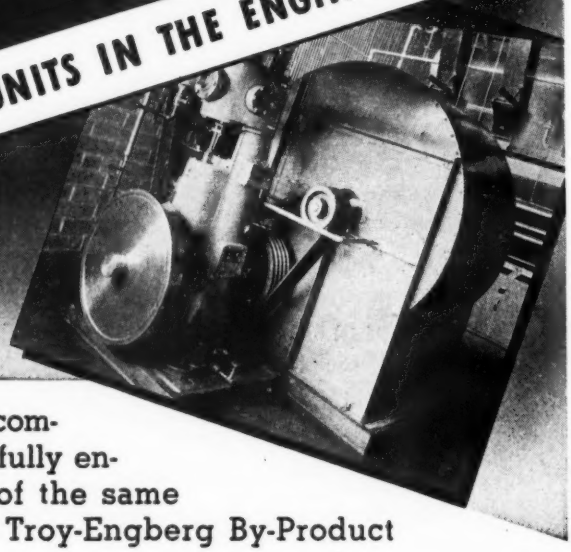
NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • TULSA • BUFFALO • CINCINNATI

TROY-ENGBERG STEAM ENGINE

By-Product Power

1 POWER for your stokers, generators, pumps, compressors

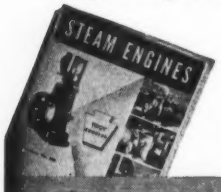
2 HEAT UNITS IN THE ENGINE EXHAUST



And both accomplished by skillfully engineered use of the same steam. This is Troy-Engberg By-Product Power at work.

Use the modern Troy-Engberg Steam Engine to drive stokers, blowers, fans, compressors, mixers, generators and pumps—THEN use the exhaust from the engine for your processing or heating, or both.

Cut Power Costs by putting your steam fully to WORK. Write us for detailed information on applying Troy-Engberg By-Product Power to your plant.



Send for Bulletin 306

TROY ENGINE & MACHINE COMPANY

Established 1870

2500 Railroad Avenue Troy, Pennsylvania

TROY-ENGBERG

STEAM ENGINES • GENERATING SETS • GENERATORS

remote power unit connected to inlet damper (3) a draft regulator responding to furnace pressure to operate an uptake damper power unit. **Ace Instrument Co, 172 Pacific St, Brooklyn 2, N. Y.**

Nylon V-Belts E317

NYLON-REINFORCED V-BELT contains a series of tough nylon cords covered with a special synthetic-rubber compound that withstands deteriorating effects of heat and oil. The belt is recommended for power transmission on equipment subject to rough usage. In addition to high tensile strength, it has great flexibility and a sufficient elasticity to absorb shock. **U. S. Rubber Co, Rockefeller Center, New York, N. Y.**

Moisture Remover E318

ELECTRICALLY CONDUCTIVE rubber strip placed between freezing compartment and regular cold chamber of a refrigerator keeps dividing member or "mullion" free of moisture without materially affecting refrigerator temperature. Strip is a resistance element without wires. It becomes warm when energized with electricity to give a steady flow of heat at low temperature. **U. S. Rubber Co, Rockefeller Center. New York, N. Y.**

Lead-Cable Wrap E319

NO-OX-ID WRAP was developed to guard lead-sheathed cables in manholes from corrosion, as well as to provide a sturdy wrapper. Its corrosion-inhibitive qualities provide a protective film to keep cables free from pitting.

It is applied by manually winding the wrap spirally, with a half-inch overlap, directly around the cable. It is available in 25-ft rolls, 2 in. wide x $\frac{1}{32}$ in. thick. **Dearborn Chemical Co, Chicago, Ill.**

Gas Analyzer E320

CONTINUOUS INDICATION of combustion completeness by a check of CO_2 can be had from a continuous gas analyzer. Top practical combustion efficiency comes when fuel-air ratio is adjusted to give highest reading on flue analyzer without any appreciable increase in stack temperature.

Analyzer consists of a recorder and 2-ft-wide by 6½-ft-high panel and a Flow Panel mounted near or at the point of sampling. It operates from a 110-v 60-cycle supply employing a wheatstone bridge and a stain-

The code calls for:

. . . two gage glasses on pressures over 400 psi

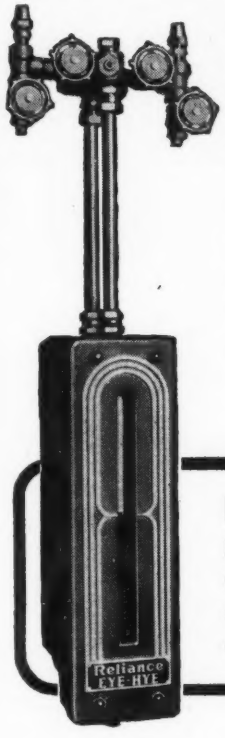
Reliance *TWIN GAGE* Water Column Assemblies

provide a simple and convenient means of complying with the code

● You adhere to code requirements for maximum safety and efficiency in operating your power plant. It's up to you to select equipment that follows code procedure and gives you *the most satisfactory service.*

Probably the best practice in applying the rule for two gages on boilers operating at over 400 psi is by means of a *water column assembly.* This provides flexibility of placement, ease of providing mechanical support, greater stability of water level indication, provision of high and low alarm signal if desired (up to 900 psi), and over-all convenience and safety of operation.

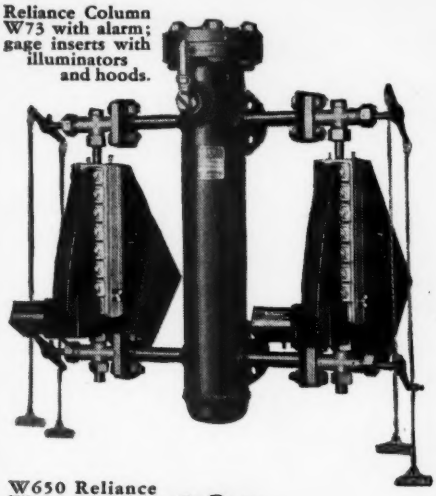
"Single water column with two gages" is the most popular selection, according to Reliance experience. Principal water column manufacturer for 63 years, Reliance practice is to give you a wide margin of safety in rugged construction, fully approved welding procedure . . . and expertly custom-made equipment. Write for information on twin gage water columns.



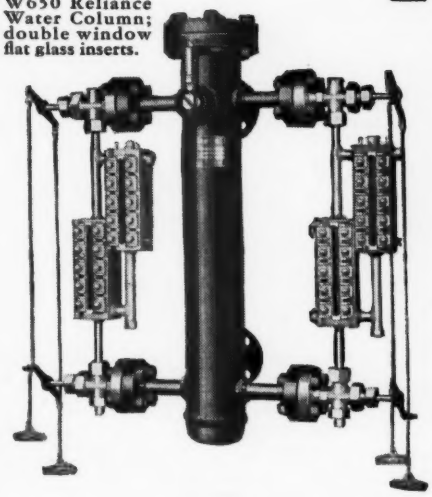
EYE-HYE Remote Reading Gage

is a "duplicate" gage that gives you accurate water level reading at convenient stations—on wall or instrument panel. Models for any pressure. More than 7000 in service.

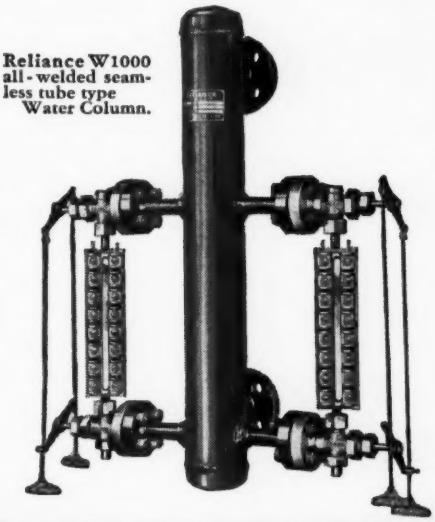
Reliance Column W73 with alarm; gage inserts with illuminators and hoods.



W650 Reliance Water Column; double window flat glass inserts.



Reliance W1000 all-welded seamless tube type Water Column.



BOILER SAFETY DEVICES since 1884

Reliance

THE RELIANCE GAUGE COLUMN CO. • 5902 CARNEGIE AVENUE • CLEVELAND 3, OHIO

No other cleaner could do it!

★ The engineer of an upstate New York university power plant with five large boilers tried every known make of tube cleaner, including our old Roto. He didn't think any of them "worth a hoot" for removing his rock-like scale.

★ When we developed the new ROTOJET, we sent him our Model 525 for field test. He was so amazed and tickled with the way this powerful new cleaner performed that he insisted on buying it. He said it was the first cleaner that ever cleaned his tubes properly, and that "it made a tough job seem ridiculously easy".

★ No tube cleaner built during our 38 years of specialization in this field can even remotely compare with the new ROTO-JET for power, efficiency, and cleaning speed. A single cleaning job with a ROTOJET will prove that you can't afford to use any other tube cleaner.

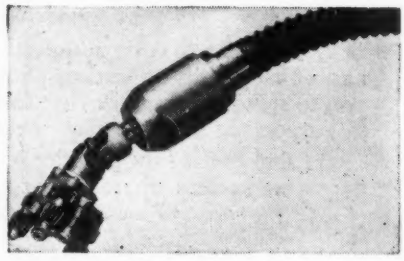
Send for new bulletin.

ELLIOTT COMPANY-ROTO DIVISION
153 Sussex Avenue Newark 1, N. J.

less-steel analysis cell for measuring thermal conductivity of stack gas. **Instrument Div, Davis Emergency Equipment Co, 45 Halleck St, Newark 4, N. J.**

Portable Crane E321

SEVEN-TON LIFT-AND-CARRY CRANE has similar configurations to 15-ton design. Group structure that controls angular adjustment of elevator track gives a broad angle of deflection that makes the track adjustable from a horizontal position to 11 deg forward of vertical. Thus, heavy loads can be picked up and positioned over rear axle for carrying, thereby improving load distribution for travel. A 3-way electric control provides pin-point spotting and placing of the load. One man controls crane by fingertip buttons from a seat in front of an instrument panel. Crane lifts capacity load without outriggers or counterweights and then carries it. Maximum lift is 29 ft 6 in. with a maximum reach of 31 ft behind center line of crane wheels. **R G Le Tourneau, Longview, Texas.**



Tube Cleaner E322

SWING-FRAME CUTTER HEAD for cleaning boiler tubes has eliminated a former trouble spot—the threaded connection. New model locks in place with the aid of a "keeper" that fits into slots in arm and cutter pin.

Cutter head consists of a spider fitted with arms that swing out under centrifugal force and allows cutters mounted on the arms to remove tube deposits. **Lagonda Div, Elliott Co, Jeannette, Pa.**

Pressure Pilot E323

DESIGNATED AS TYPE DD-1 direct-acting, and *DR*-1 reverse-acting, these control pilots provide constant differential pressure for process work. Operating medium may be air, clean water, oil or gas. Controls are available for ½ to 6 psi, 2 to 20 psi, and 15 to 75 psi. Maximum total static pressure for all types is 300 psi, based on continuous operation provided both pressures are maintained within differential range of the pilot. **Leslie Co, 50 Delafield Ave, Lyndhurst, N. J.**

Textile Motor E324

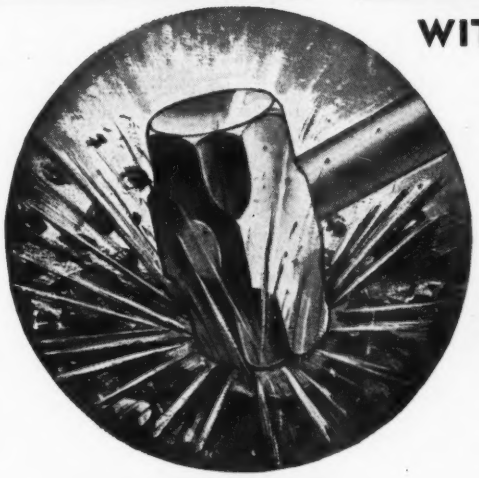
SUITABLE FOR SPINNING, twisting and roving frames, as well as other applications common in textile mills, the *Quick-Clean* motor has prelubricated, double-sealed ball bearings, making servicing, according to maker, practically unnecessary for a 5-year period.

Starter yoke is of cast iron with a specially designed external contour that

Better Coal Preparation for Greater Combustion Efficiency

WITH

AMERICAN SHREDDER RING CRUSHERS



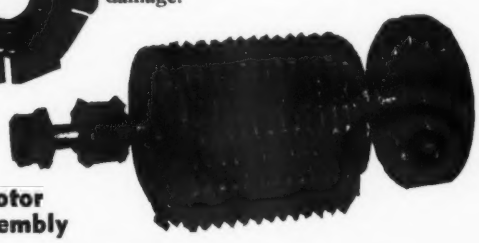
= RAGGED FIRE BED
= EXCESSIVE CO_2
= ASH PIT LOSS

= EVEN FIRE BED
= UNIFORM COMBUSTION

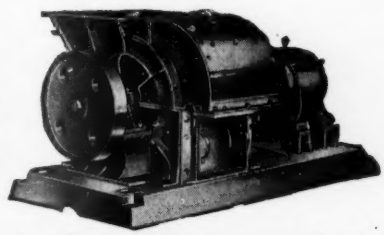
Every pound of coal means *more* BTU's—more efficient heat, when Americans do the preparation job! ROM coal is reduced rapidly with exacting control of fines, uniform sizing and no oversize—at a cost of less than 1¢ a ton. The result: Americans pave the way for a loose, uniform firebed quickly responsive to sudden steam demands—without excessive ashpit drop or unnecessary CO_2.

Shredder Ring

Patented manganese steel shredder rings, exclusive with American Rolling Ring Crushers, *split the coal* by impact rather than by crushing. Shown below is the rotor assembly, with its many rows of shredder rings. Each ring has twenty cutting edges — and revolves on individual shaft, free to deflect from tramp iron without damage.



Rotor Assembly



American Type "S" Rolling Ring Crusher, with heavy cast steel housing and sectional construction, secured at dust-tight machined joints with coupling bolts for easy access to crushing chamber.

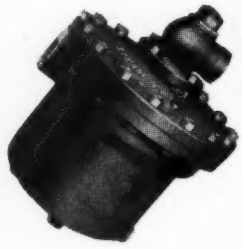
Write for details on efficiency of coal preparation in power plants with American Crushers.

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 MACKLIND AVE.
ST. LOUIS 10, MO.

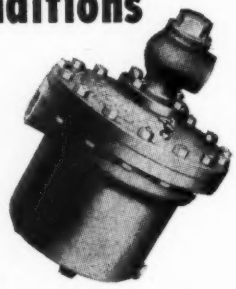
• This No. 110 Stickle Steam Trap weighs only 4½ pounds. It has a capacity of 500 lbs. per hour. Three larger sizes, making four traps in Stickle 100 Series, supply a capacity range up to 3,000 lbs. per hour. Supply exceptionally desirable drainage for unit heaters, laundry equipment, jacketed kettles and other smaller size processing equipment operating at medium and high pressures. No complicated internal mechanism to get out of order—Stickle Open Float design makes both for simplicity in construction and positive operation. Internal strainer keeps dirt particles from reaching valve. Trap bypassed by quarter turn of nut at top. Body removable without taking trap from line. Designed for economical straight-in-line installation. In every way a more efficient steam trap. Ask for Bulletin No. 115.



• Stickle AE Series Traps built for working pressures up to 200 lbs. (450 lbs. if made of steel). Capacities approximately four times old standard traps of comparable size. Seven sizes supply capacity range of 5,000 to 21,000 lbs. an hour. Ask for Bulletin No. 315.

All of these Advantages in Steam Traps for YOUR Operating Conditions

1. **DEPENDABLE SERVICE**—Stickle obviates most "steam trap troubles" with the natural Stickle Open Float Principle, and stark simplicity of construction. Location of valve in top of trap prevents scale and dirt obstruction.
2. **POSITIVE OPERATION**—Filled open float releases valve for trap discharge. Emptied open float regains buoyancy and closes valve. Both actions instantaneous—positive—frictionless. No steam blown at end of discharge—perfect water seal at all times. Air and gases eliminated with each discharge.
3. **FREEDOM FROM REPAIRS**—Absence of hinges, levers, pins—all unnecessary mechanical parts—leaves few things to repair or replace. Chromium valve and seat, always in perfect fit through constant regrind action of trap in operation, never stick.
4. **MAXIMUM CAPACITY WITH MINIMUM SIZE** — Large capacity of Stickle Traps in ratio to size affords installation convenience as well as installation economy. Each series, or design, of Stickle Traps built to meet specific conditions and give best results and most efficient performance under operating requirements.



• Stickle Series 50 Pop Valve Traps built especially to meet the special drainage requirements of evaporating, cooking and other processing equipment operating at high pressures, creating large volumes of condensate. Ask for Bulletin No. 515.
• Stickles Series T Traps for low pressure and for vacuum service described in Bulletin No. 415.

STICKLE STEAM SPECIALTIES COMPANY
2265 Valley Avenue, INDIANAPOLIS 18, INDIANA

Successfully Serving for More than 40 Years Paper Mills, Food Processors, Textile and Hosiery Mills, Laundries and Other Manufacturers Using Steam for Industrial Processing

STICKLE EQUIPMENT

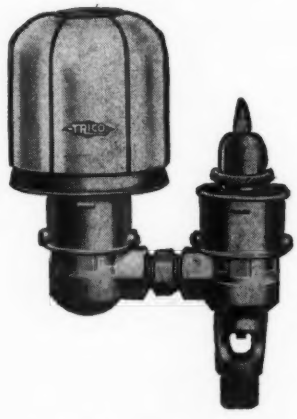
STICKLE DIFFERENTIAL AND BOILER RETURN SYSTEMS • STICKLE OPEN FLOAT STEAM TRAPS • STICKLE REGULATING AND REDUCING VALVES • STICKLE OPEN COIL FEED WATER HEATERS AND PURIFIERS • STICKLE OIL AND STEAM SEPARATORS STICKLE TEMPERATURE CONTROLLERS AND OTHER SPECIALTIES

provides a smooth nonobstructing flow to ventilating air, after it passes through openings in bearing brackets. These brackets are specially machined and finished to prevent building up of lint.

Motor is available in 3, 5, 7½, 10 and 15 hp sizes. **Allis-Chalmers Co, Milwaukee, Wis.**

Plug Valve E325

CORROSION-RESISTANT all-bronze plug valve is designed primarily for breweries and process industries. Valve has no resistance to flow when open, no turbulence, and is self-cleaning and easy to operate. It can be furnished with flanged or threaded male or female connections or hose-coupling threads. The 2-in. size has pipe connections for flowmeter, gage, bypass clean-out, and gas injector. The 3-in. size can be furnished 3-way or 2-way, as desired. It is made in sizes ½ to 4 in. **Ampco Metal Inc, Milwaukee 4, Wis.**



Gravity Feed Oiler E326

UNIT ILLUSTRATED maintains an accurate constant level of oil in the gravity feed mechanism. This feature assures an accurate rate of feed, regardless of amount of reserve oil in the bottle. Dirt cannot reach bearings or clog needle valve, as oil is thoroughly filtered through removable filter.

Oiler is mounted at top of the part to be lubricated, and any predetermined quantity of oil may be obtained in drop fashion by simple adjustment of needle valve. After desired adjustment is made, no further attention is required except to keep a reserve supply of oil in the large capacity bottle. Oiler is suitable for lubricating solid bearings where an accurate rate of feed as well as clean filtered oil is essential. **Trico Fuse Mfg Co, 2948 N 5th St, Milwaukee, Wis.**

Cation-Exchange Resin E327

AMBERLITE IR-105 synthetic-resin cation-exchange material has (1) smooth spherical shape, (2) no odor, taste or color-throw, (3) highly uniform particle size, (4) high density, (5) rugged physical properties, and (6) gives high exchange capacity at efficient regeneration levels. The resin is shipped in sodium form, but can easily be converted to hydrogen deriva-

"High-Spots" ON THE HIGH-PRESSURE MAP

Nearly one thousand Worthington High Pressure Centrifugal Pumps, now in boiler feed service, are a testimonial to Worthington's continuous leadership in pump design and manufacture. A long list of pace-setting Worthington design-features have helped to advance feed pressures up to 2400 psi. For example, the Elastic Seal Ring, for tight interstage joints in axially split casings, and the Metal-to-Metal Ring Type Joint in solid-case pumps.

Worthington Centrifugal Pumps Meet the Demand for Steadily Rising Boiler Feed Pressures

Each dot represents a Worthington Boiler Feed Pump rated at higher than 750 psi. Many similar Worthington installations in other countries increase the grand total.

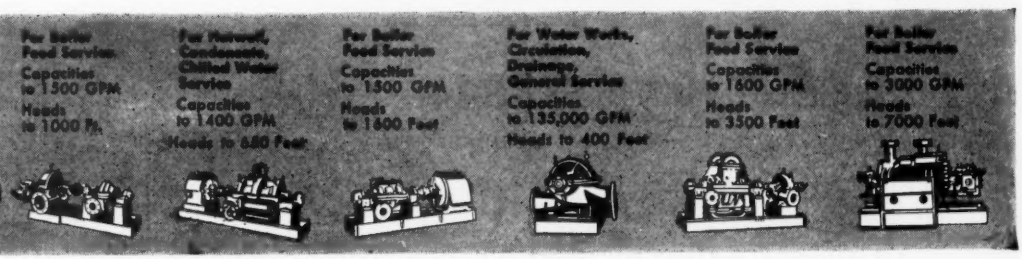
Get the RIGHT Pump for the Job

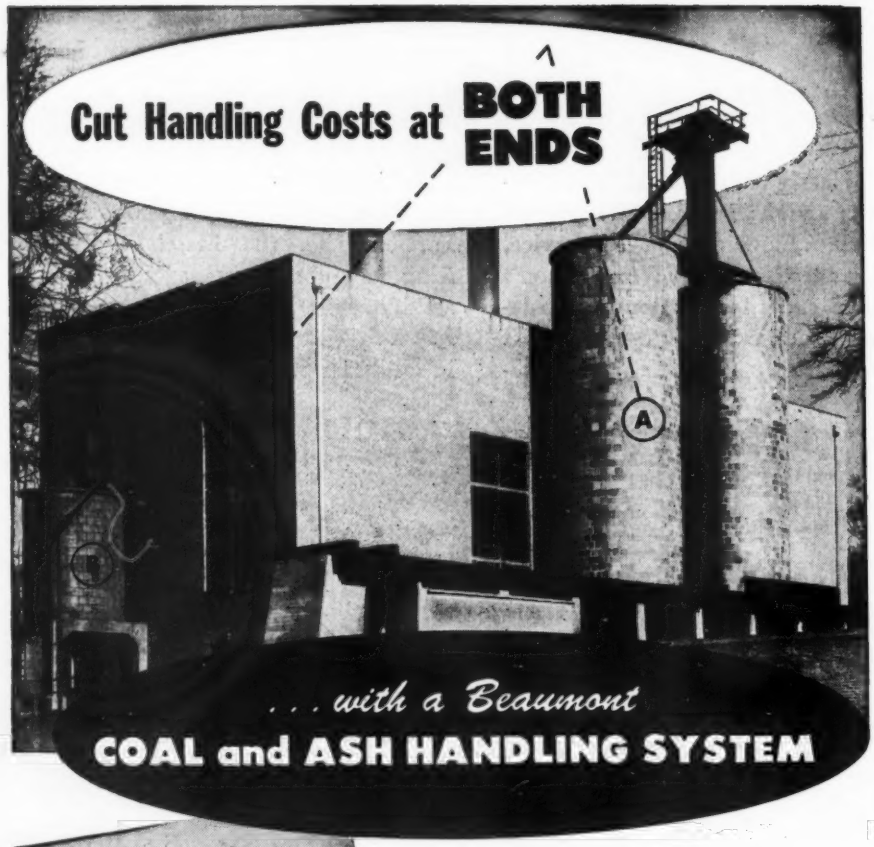
Worthington builds Standard Centrifugal Pumps in all sizes, pressures and capacities. This most complete line offers you the widest choice . . . your one best bet for pumping-satisfaction. And you can count on Worthington engineers, backed by the longest and broadest experience in the field, for expert aid in any pumping problem. For the dependability, economy and long service-life that prove *there's more worth in Worthington*, come to Pump Headquarters. Call our nearest District Office, or write to *Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, N. J.*

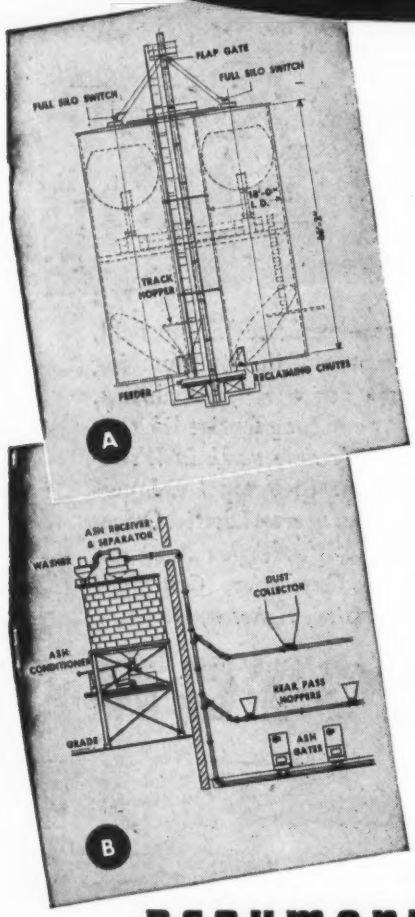
WORTHINGTON

C8-1

THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB


For Boiler Feed Service
Capacities to 1500 GPM
Heads to 1000 Ft.
For Flatwell, Condensate, Chilled Water Service
Capacities to 1400 GPM
Heads to 680 Feet
For Boiler Feed Service
Capacities to 1500 GPM
Heads to 1800 Feet
For Water Works, Circulation, Drainage, General Service
Capacities to 135,000 GPM
Heads to 400 Feet
For Boiler Feed Service
Capacities to 1600 GPM
Heads to 3500 Feet
For Boiler Feed Service
Capacities to 3000 GPM
Heads to 7000 Feet





COAL HANDLING

With Beaumont Birch Coal Handling Equipment, one operator controls all coal from the time it arrives by rail and is dumped in the track hopper, through its lifting by bucket elevator, to its use —immediate or future.

ASH REMOVAL

The Beaumont "Vac-Veyor" system offers the most direct and economical method for removal of ashes, siftings, soot and dust. They are vacuum conveyed through a pipe from their source to an ash receiver and separator—then into the silo where they remain until final disposal.

Beaumont engineers design and erect this equipment—a complete coal and ash handling system. This brings you savings in installation as well as in handling costs—you have one contract, we have sole responsibility.

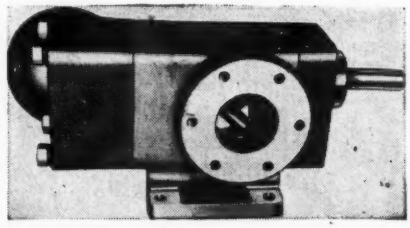
Write for more information to:

BEAUMONT BIRCH *Company*

1502 RACE STREET—PHILADELPHIA 2, PENNA.

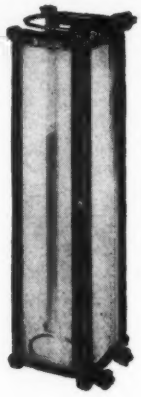
Designers Manufacturers Erectors BULK MATERIAL HANDLING SYSTEM

tive by treatment with mineral acid. *Amberlite* IR-105 has a density of about 47 lb as shipped, a moisture content of 40 to 50%, a wet-screen grading of 16 to 50 mesh, an effective particle size of 0.4 to 0.6 mm, maximum uniformity coefficient of 1.7, and voids of about 45%. **Resinous Products & Chemical Co, Philadelphia 5, Pa.**



Helical-Rotor Pumps E328

POSITIVE DISPLACEMENT PUMPS have two helical rotors, one driving and the other an idler, that force the liquid ahead in an axial flow. Shaft of driving rotor is mechanically sealed against leakage by an anti-friction shaft seal. Built in two sizes, these pumps are primarily designed for handling oils at 50 or 70 gpm, at pressures up to 125 psi. **Syntron Co, Homer City, Pa.**



Gage Glass Guard E329

SAFETY FIRST plastic guard is for gage glasses on boilers and in chemical, refinery and other industries. Guard is reinforced to stand up under severe shock and is made in various sizes to specifications. **Ernst Water Column & Gage Co, Livingston, N. J.**

Network Transformer E330

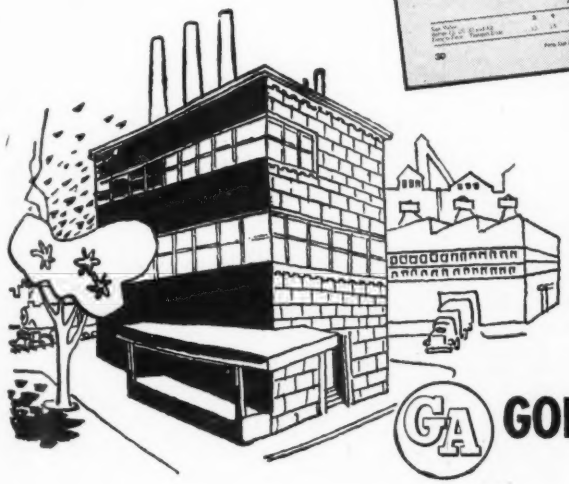
INSULATED WITH SILICONE-GLASS, this dry-type network transformer is suitable for service in buildings as well as sidewalk and street vaults. Since it is constructed with inorganic insulation and contains no inflammable oils, fire and explosion hazards are eliminated. Fireproof vaults are not required. Effectively sealed by welding, the transformers can operate when submerged by flooding.

Units are available in both 5- and 15-kv classes, in sizes of 150, 225, 300, 500, 600, 750, and 1000 kva, 3-phase. High-voltage switches and low-voltage network protectors can be supplied either mounted on the transformer or for separate mounting. **Westinghouse Electric Corp, Pittsburgh 30, Pa.**

Golden-Anderson

VALVES

over 1500 types and sizes for engineered protection



Since 1905

For more than 35 years **Valves by Golden-Anderson** have proven satisfactory in the protection of life and property. **Engineer**-designed to give safe, dependable control **under** even the most difficult and adverse **conditions.** For complete informative and **technical** data, send our engineering department your most difficult assignment.

GOLDEN-ANDERSON *VALVE* Specialty Company

Keenan Building · **Pittsburgh 22, Pa.**

MORE POWER TO YOU!

BELMONT 319
Hollow Center Packing

For low and intermediate steam; hot and cold water rods and plungers; steam hammers and elevator plungers.

Philadelphia, Pa. No matter how small — power leaks are costly. That's why Belmont takes such minute care in the construction of all Belmont Packings.

Take Belmont 319, for example. Only the finest quality rubber frictioned duck is used. The hollow center provides a point of least resistance for contraction and expansion. It serves to keep friction at a minimum, since the packing tends to "breathe" towards the "hole" as varying pressures are exerted upon it in the stuffing box.

The construction of Belmont 9 permits the combination of two distinctive materials into one integral packing. The rubber and duck channel acts as a wiper and also a protection to the flax. The linen thread stitching prevents material displacement and buckling so frequently experienced in unstitched packings of this type

BELMONT PACKINGS

BELMONT 9
Special Hydraulic Channel Flax

For all hydraulic services from low pressure to extreme heavy duty, hot and cold water.

Belmont Packings are easy to obtain and convenient to see; distributors are located in every large center, with sample kits displaying Belmont materials and constructions.

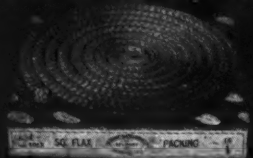
Identification is simple, Belmont Packings wherever practicable, are packed in attractive and secure boxes, bearing our orange-colored trade-mark on a blue background.

The Belmont Catalog is available. This invaluable reference book reduces packing facts down to simplest forms. Write on your company letterhead for free copy.

Investigate how Belmont can serve you! Contact your local distributor or write us direct.

THERE'S A BELMONT PACKING FOR EVERY SERVICE

Steam, Water, Oil, Gas, Air, Acids, Alkalies, Ammonia



Rings, Spirals, Coils, Reels, Spools, Sheets, Gaskets.

THE BELMONT PACKING & RUBBER COMPANY
BUTLER AND SEPVIVA STREETS • PHILADELPHIA 37, PA.

Power News

(*Continued from page* 132)

are thumping for intensified effort toward completion of the current 5-year program that called for "increasing the output of gas through underground gasification by 1950 to 920 million cubic meters per year."

Citing this goal in a recent article that noted Soviet pioneering work in underground gasification as a means to utilize low-grade coals and provide cheaper fuel, A B Chernyshev, corresponding member of the USSR Academy of Sciences and a prominent colleague in the Academy's Power Institute, expressed confidence that the combined efforts of Soviet engineers, scientists and workers would result in converting "underground gasification of coal into an independent branch of industry."

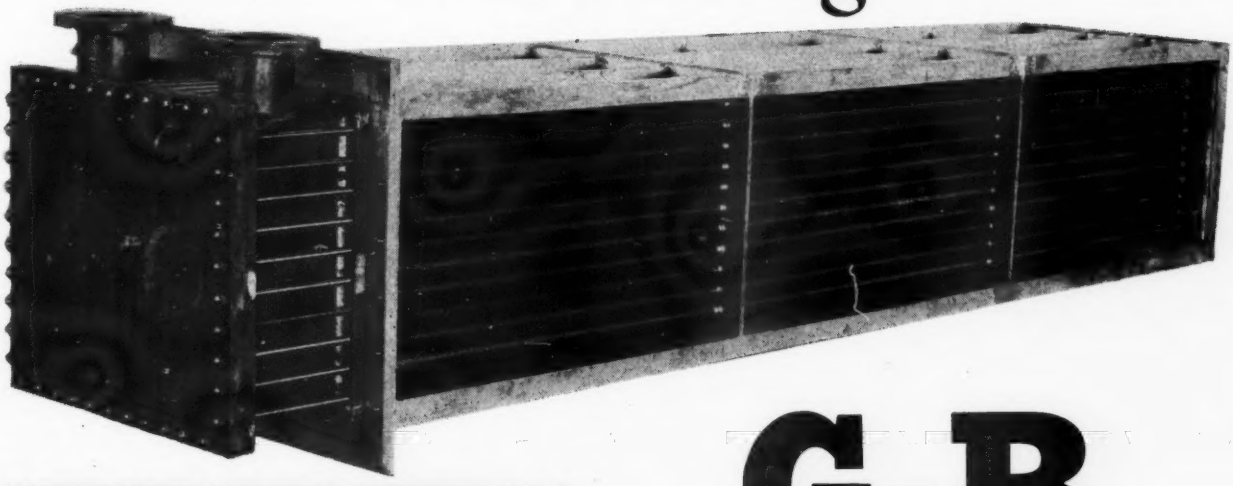
Academy correspondent Chernyshev noted that Soviet work in this field has been underway since 1931 when at the initiative of Stalin a government commission for underground gasification of coal was established. Under its auspices the "Podzemgas" (underground gasification) trust was organized in 1932, and six years later the experimental station established in the Donbass produced gas, by underground gasification, that was used in firing the boilers of a coke plant "for the first time in world technique." Results were "entirely satisfactory" and in 1940 a second plant for underground gasification of coal was established in the Moscow coal basin.

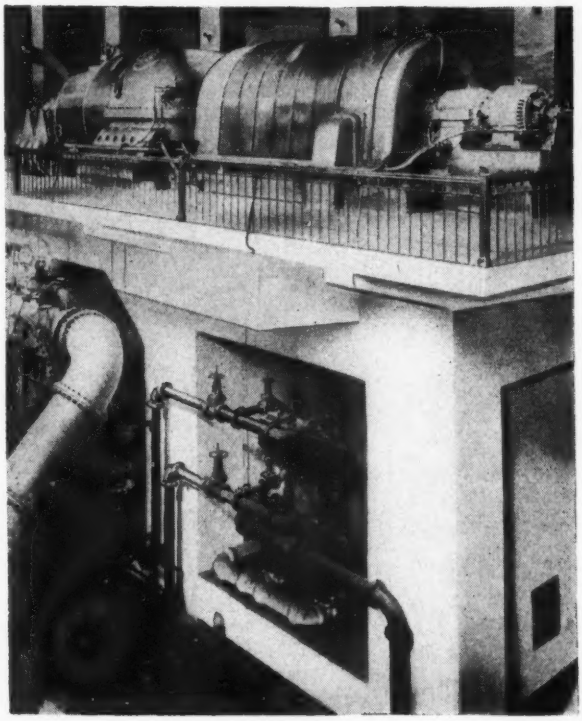
Stevens Institute of Technology conferred the Degree of Doctor of Engineering, Honoris Causa, upon Ernest H Peabody, president and founder of Peabody Engrg Corp, at their regular June commencement exercises. Dr Peabody has long been active in development and perfection of combustion equipment.

Westinghouse Electric Corp's Buffalo divisions have raised prices on some lines of electric motors, engine-driven generators and industrial control equipment. A 5% increase went into effect midnight July 2 on small and medium motors (1 to about 200 hp) engine-driven generators of about 150 kw and smaller, and motor-generator sets comprising these types of apparatus. Also, all industrial control equipment was increased 10% in price on that date.

Plans for construction of an addition of a 100,000-hp turbine-generator at Westover plant of New York State Electric & Gas Corp have been announced.

Do Your Generators Need Air Conditioning?





G-R

K-FIN GENERATOR AIR COOLER

A G-R K-Fin Air Cooler System is as far superior to ordinary forced draft circulation through generator windings as an air conditioning system is to a fan.

With open forced draft, the heat from generator windings is merely distributed through the engine room, dust accumulates in the windings, and the generator heat loss cannot be reclaimed.

By circulating the air for generator windings in a closed circuit and cooled by a G-R K-Fin Air Cooler, you obtain many benefits. Generator operation becomes quieter and cooler. Fire hazard is eliminated . . . the limited amount of oxygen in the closed system cannot support combustion. The windings remain clean . . . generator maintenance expense is reduced. Electrical heat energy can be recovered by using the condensate as the cooling medium.

The wide-spread recognition of these important advantages is indicated by the use of G-R Air Coolers with generators totaling well over 7,000,000 kw, ranging in size from 500 kw to 160,000 kw. Bulletin 1219 describes these units in detail . . . write for your copy.

GR-194

THE GRISCOM-RUSSELL CO.
285 MADISON AVENUE, NEW YORK 17, N. Y.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

4 REASONS

DARTS DON'T DRIP

1. **EVERY DART . . .** is precision-machined to a true ball joint . . . then spherically ground to give wide, true-bearing surfaces. Reason why Darts fit snugly without excessive wrenching . . . are always leakproof.

2. **EXTRA-WIDE BRONZE SEATS . . .** resist pitting, electrolysis and corrosion . . . stay drop-tight.

3. **EXTRA-HEAVY SHOULDERS . . .** shrug off wrench abuse through dozens of installations.

4. **PRACTICALLY INDESTRUCTIBLE . . .** body and nut of air-refined, high test malleable iron resists stress, stretching and wrenching . . . ensures that connections will stay tight.

See your supplier today about these outstanding, money-saving features of Dart Unions.

E. M. DART MANUFACTURING CO.
PROVIDENCE 5, RHODE ISLAND

DART
UNIONS

When you sell Darts you are selling the quality union that means year after year repeat business.

Coming Events

(*Continued from page* 132)

ton, Mass. E S Whitten, publicity chairman, NEMHE, Mechanics Hall, Boston, Mass.

Oct 11-13 — National Lubricating Grease Institute, 16th annual convention, Edgewater Beach Hotel, Chicago, Ill. Carl E Bolte, executive secretary, 4638 Mill Creek Parkway, Kansas City 2, Mo.

Oct 18-20—Engineers' Society of Western Pennsylvania, ninth annual water conference, Hotel Wm Penn, Pittsburgh, Pa. H M Olson, chairman of water conferences, c/o Ohio Salt Co, Pittsburgh, Pa.

Oct 18-22—American Institute of Electrical Engineers, Midwest general meeting, Hotel Schroeder, Milwaukee, Wis. H H Henline, secretary, 33 W 39th St, New York 18, N. Y.

Oct 18-22—National Safety Congress & Exposition, meetings in Stevens, Congress, Palmer House, Morrison and Sherman Hotels, Chicago, Ill. G E Burns, 20 N Wacker Dr, Chicago, Ill.

Nov 3-5—American Institute of Electrical Engineers, Southern district meeting, Tutwiler Hotel, Birmingham, Ala. H H Henline, secretary, 33 W 39th St, New York 18, N. Y.

Nov 28-Dec 4—American Society of Mechanical Engineers, annual meeting, Pennsylvania and New Yorker Hotels, New York, N. Y. Ernest Hartford, executive assistant secretary, 29 W 39th St, New York 18, N. Y.

Nov 29-Dec 4—18th National Exposition of Power & Mechanical Engineering, Grand Central Palace, New York 17, N. Y. Charles F Roth, manager, Grand Central Palace, New York 17, N. Y.

Boiler Manufacturers Meet in Canada

Breaking a long-established custom, the 60th annual meeting of American Boiler Manufacturers Association and Affiliated Industries was held in the spacious central lodge of the Seigniory Club, Province of Quebec, Canada.

As usual at ABMA annual meetings the morning sessions were devoted to business and the afternoons to golf.

Newly elected officers for the coming year are: Raymond J Bros, president; Pell W Foster Jr, vice-president; A C Baker, secretary-treasurer.

Alfred Iddles was elected trustee for the unexpired term of A G Pratt and the following were elected for 3-years each: Raymond Bros, Starr H Barnum, R J Stormont and J S Bennett.

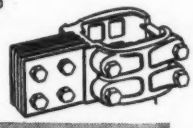
In the golf competition J A McBride won the Paul B Huyette trophy, Hugh L McCulloch won the Geo L Bourne trophy and Walter Locke the Canadian Steel Boiler trophy.

MAKE CONNECTIONS THREE WAYS

...with Chase Square Bus Conductors!

1 CLAMP TYPE JOINTS

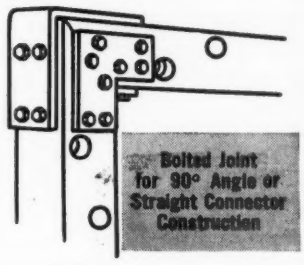
Straight Connector Tube to Tube



Tee Connector Tube to Bar

Tee Connector Tube to Tube

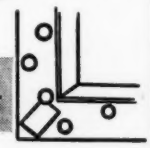
2 BOLTED JOINTS



Bolted Joint for 90° Angle or Straight Connector Construction

3 BRAZED JOINTS

Tee Joint



90° Angle Joint or Straight Connector

THREE different types of connections can be used on installations of Chase Square Copper Bus Conductors—clamping, bolting or brazing. In addition, the four flat sides permit adequate and uniform pressure to be exerted between the large contact surfaces, resulting in firm, secure joints.

For information on other advantages of Chase Square Copper Bus Conductors, ventilated and unventilated, send for our new illustrated booklet to Dept. PO98.

Chase

the Nation's Headquarters for
BRASS & COPPER

WATERBURY 91, CONNECTICUT — SUBSIDIARY OF KENNECOTT COPPER CORPORATION

THIS IS THE CHASE NETWORK . . . *handiest way to buy brass*

ALBANY† ATLANTA BALTIMORE BOSTON CHICAGO CINCINNATI CLEVELAND DETROIT HOUSTON† INDIANAPOLIS KANSAS CITY, MO. LOS ANGELES MILWAUKEE MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER† SAN FRANCISCO SEATTLE ST. LOUIS WATERBURY (†Indicates Sales Office Only)

VIKING ...originators

of the DESIGN THAT MADE ROTARY PUMPS FAMOUS!

Sept. 1948

All Rotary Pump Users,
Everywhere.

Gentlemen:

Youre right! Today's market is cluttered with rotary pump manufacturers. For many it is just a sideline.

But with well over a million Viking Rotary Pumps in service today throughout the world, shrewd pump buyers in every field of industry and commerce prove they prefer the pump that is different!

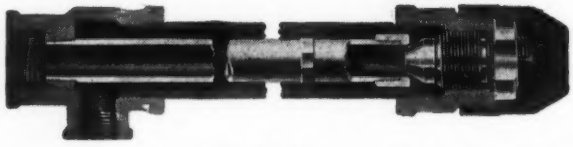
Get the facts!... Write today for complete bulletin

Yours Very Truly,
Viking Pump Company
Cedar Falls, Iowa.

Nicholson Expansion Steam Traps Solve . . .

"SLOW HEAT-UP"

Due to Air Binding



MANY APPLICATIONS

This widely used Nicholson trap is applicable to all equipment using steam or hot water for heat or power, for example:

Radiators
Separators
Paper Machinery
Pipe Coils
Kettles
Railway Coaches
Dry Kilns
Vulcanizers
Switch Heaters
Laundries
Plastic Molding Presses

Among the features of this simple and widely adaptable trap is its positive action. Closes tight when steam is in trap, opens wide when cold, rendering it proof against freezing and air-binding. Adjustable valve for passing condensate at any desired temperature. Pressures: 0 to 250 lbs. without change of valve or seat. Length: 18" to 40".

TRAPS FOR EVERY PURPOSE — power, heat, process. Weight and piston-operated traps for steam, air and gasoline pressures to 1500 lbs.; thermostatic steam traps, pressures to 225 lbs.; radiator traps, pressures to 15 lbs. CATALOG 448.

W. H. NICHOLSON & CO.

125 OREGON STREET, WILKES-BARRE, PA.

Manufacturers of Steam Specialties for Over 75 Years

Hydro-Pneumatic Tanks

(*Continued from page 77*)

hand, a tank under pressure control only, receiving water from a booster pump, experiences a rising water level because original air within the tank is absorbed.

A coordinated control of pressure and water level permits governing all involved factors. With it a reserve of 5 to 6% of tank capacity is adequate. This allows a lowering of original high level setting and the greatest possible withdrawal for a given pressure drop. Fig. 3, 4, 5 illustrate the action obtainable with different pressure on-off limits at different pressure settings. As pressure range goes up it becomes increasingly necessary to lower the high-level setting or to spread the differential between on-off pressure limits.

This brings us to the last important point. Note from the figures the advantages obtainable by adjusting the differential Actually, the choice of the usual 20-lb differential happens only because that is the inherent differential of the inexpensive pressure switches most commonly used. If the differential were determined in accordance with efficiency requirements, completely different settings would often be used.

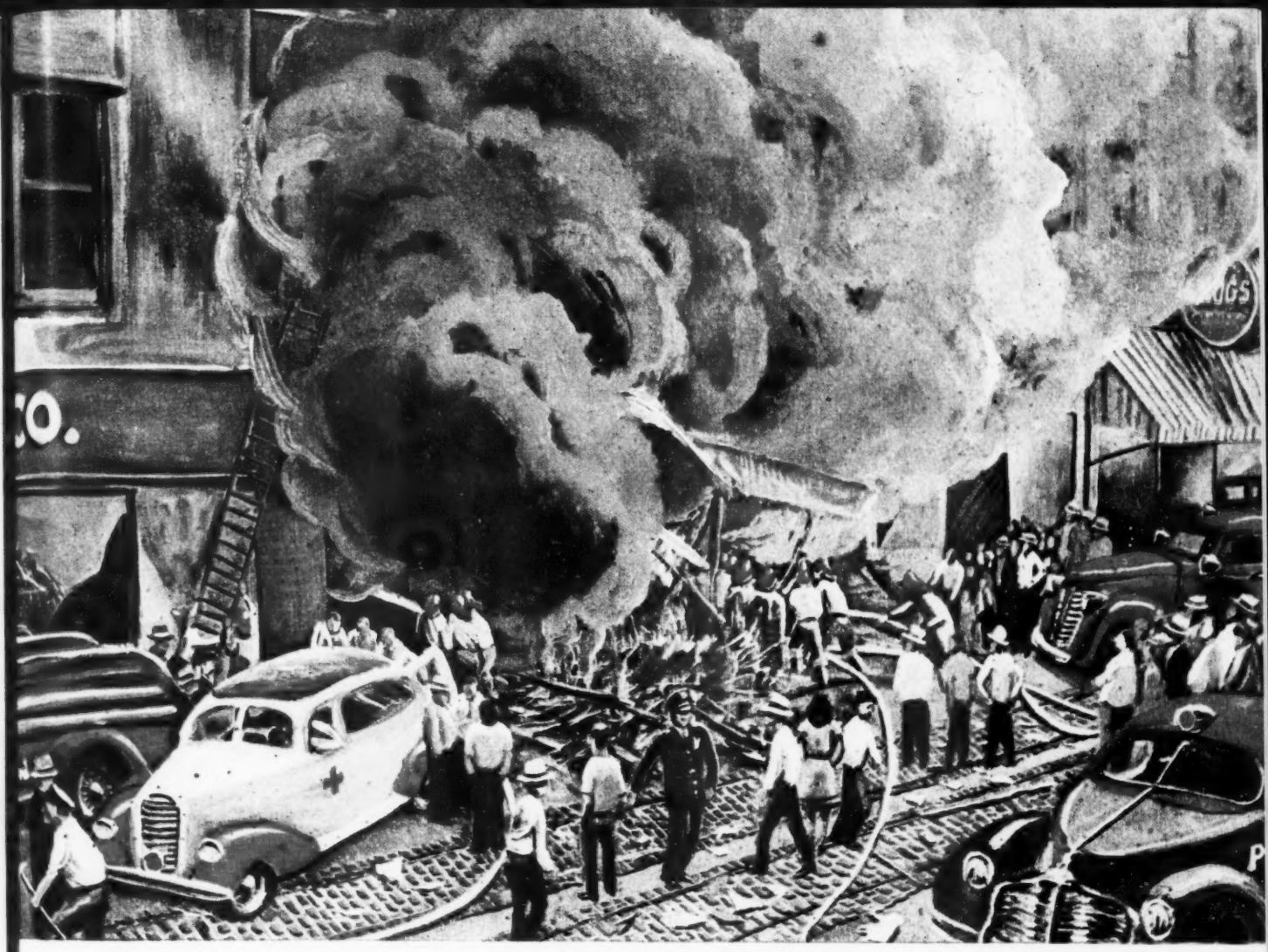
Although here presented in formula and chart form, all this information can be reduced to slide-rule form. Such a rule has been developed. By using this slide rule, which shows withdrawal from tank for any given setting at various air-water ratios, the most efficient operation can be quickly determined. This, then, allows determination of the proper tank size so the pump will not start more than a predetermined maximum number of times per hour.

The steps involved are:

1. Determination of maximum demand.
2. Determination of pressure requirements of system.
3. Selection of pump to meet max demand at required pressure.
4. Slide-rule determination of optimum air-water ratio at required settings.
5. Selection of tank size in accordance with findings.

Example: To determine tank size, to limit pump starts to 6 per hr:

1. Max demand is 400 gpm.
2. Pressure requirements 35 psi minimum, not more than 65 psi safely.
3. Chose pump to deliver 500 gpm at 40 to 50 psi.
4. Slide rule shows best 60/35 opera-



TEN MINUTES EARLIER, *There Was Still Time**...

Five dead. Thousands of dollars' damage. Insurance? Yes, but . . .

This explosion could have been prevented at a cost of $22.50. A Black, Sivalls & Bryson SAFETY HEAD . . . which gives instant relief when over-pressure threatens . . . could have done the job.

In 100,000 plants where BS&B SAFETY HEADS are used, no vessel protected by a SAFETY HEAD has ever exploded.

If you employ pressure . . . don't wait another day! Consult with your Plant or Maintenance Engineer. Write for complete cost covering your installation needs; Industrial Power Department, Black, Sivalls & Bryson, Inc., Power and Light Building, Kansas City 6, Missouri.

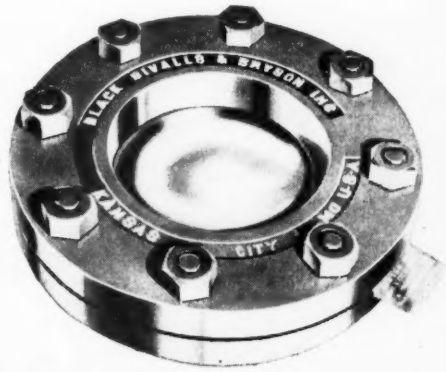


*Illustration is an artist's conception of an actual explosion in a Department Store which took the lives of five people, injured countless others, and caused property damage amounting to thousands of dollars.

EFFICIENCY RELIABILITY

FOREIGN INQUIRIES INVITED Cable Address: BLACK, KANSAS CITY, U.S.A.

BLACK, SIVALLS & BRYSON, INC.

KANSAS CITY, MO. OKLAHOMA CITY, OKLA.

FLEXIBILITY ARMED AGAINST ABRASION

Penflex Tubing provides strength and flexibility for air conveyor... durability to withstand abrasion.

Copra, thousands of tons of this tough, dried kernel of the cocoanut to be unloaded in West Coast ports. Huge pneumatic conveyors were the answer, but the tubing used for sucking the copra out of the holds of the ships had to be flexible for changing position . . . tough and armored to withstand terrific abrasion.

Penflex "Flexineering" had the answer! Lengths of Penflex full interlocking galvanized steel flexible #20 heavy duty hose (8" and 10" I.D.) were installed. This Penflex product answered every requirement—provides maximum flexibility for free movement of hose in hold, absorbs vibration from machine, takes up movement of ship due to rough water and rise and fall of tide.

Penflex "Flexineering" (the science of engineering each type of flexible metallic tubing to your particular problem) can help you solve many problems of maintenance, production and product design.

Penflex manufactures a complete line of 4-wall interlocked flexible metallic hose from ½" diameter to 30" diameter. Also, seamless welded flexible tubing from 5/32" diameter to 2" diameter, automatic barrel fillers, rivet passers, and hose for tar, asphalt, laundry presses, steam, diesel installations, etc. We offer our engineering service and products to improve your production. For further information on the above case of unloading write to . . .

PENNSYLVANIA FLEXIBLE METALLIC TUBING COMPANY

7238 Powers Lane **Philadelphia 42, Pa.**

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Penflex... HEART OF INDUSTRY'S LIFE LINES

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We Studied Safety Valve *CAPACITY*

—Here's what we found out about VOLUME CONTROL

We found . . . that there's a lot more to "full capacity" than a full bored nozzle and high lift. Ability to *pass* steam and ability to *control* it are two entirely different things.

We found . . . that the first step toward control is to get rid of turbulence, and that by guiding the flow over properly designed, smooth machined surfaces, we could reduce turbulence to a negligible minimum.

We found . . . that the steam passing through a full bore exerts tremendous lifting power, tending to keep the valve open long after the overpressure has been relieved . . . but . . . when *part* of this force is spilled through an adjustable exhaust belt, the valve can handle full volume and still reseat promptly.

To you . . . this high relief capacity means fewer valves to buy—fewer valves to service. In one actual installation, 5 Foster 38-Sv's replace 12 "conventional" safety valves of the same nominal size. Other guaranteed advantages are . . . tight seating . . . consistently accurate popping . . . minimum blow-down, which can be held to as little as 1% . . . and extremely low maintenance.

For full details on the design and construction features that enable this valve to out perform any other safety valve, get in touch with your Foster Representative or with us direct.

FOSTER ENGINEERING Company

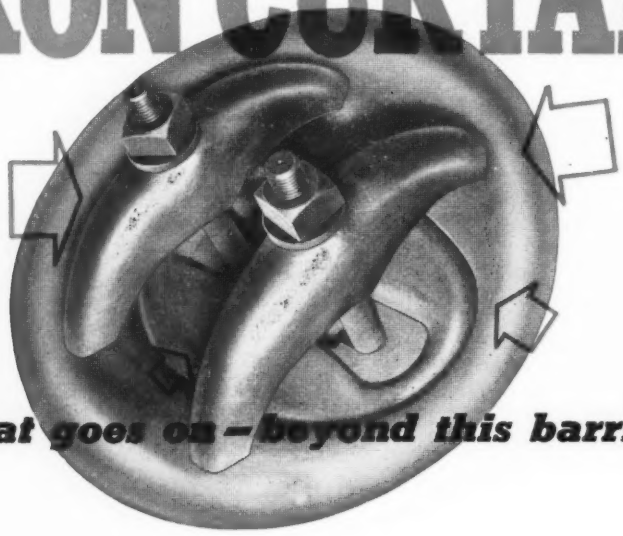
PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS... PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

106 MONROE STREET • NEWARK 1, N. J.

Visit the THIRD NATIONAL INSTRUMENT EXHIBIT at Convention Hall, Philadelphia, Pa., September 13-17, 1948. See our display in Booth 442.

71-1-1

BEHIND THE IRON CURTAIN



what goes on—beyond this barrier?

Not always what theory teaches us. More than modern instrumentation can tell us. Much, indeed, that only off-the-line inspection will reveal — too late, perhaps, for corrective action.

Yet here-and-now facts on the condition of internal boiler surfaces are always yours when APEXIOR NUMBER 1 guards tube and drum steel.

For APEXIOR permanently stabilizes metal beneath a surface which moisture cannot penetrate. Thus isolated from any environment with which it can react to its own detriment, APEXIORized steel loses none of the characteristics of new or newly cleaned metal — can be depended upon for changeless year-in, year-out service.

A further benefit is that APEXIOR's smooth surface attracts fewer and less tenacious deposits so that tubes and drums stay cleaner longer for uniform heat distribution, better circulation and constant high heat transfer efficiency.

These are some of the reasons why for 31 years APEXIOR has played so important a role in the power plants of American industry — why today engineers in ever-increasing numbers specify it for boilers of all pressures and ratings, operating under all conditions of feedwater control.

For a complete picture of what APEXIOR protective surfacing can mean to your boiler, write us for more facts about

DAMPNEY Maintenance for Metal

THE DAMPNEY COMPANY of AMERICA • Hyde Park, Boston 36, Mass.

tion is with 40% high level, allowing 30% of tank to be withdrawn.

5. Max pump starts per hour is with demand one half of pump capacity, that is, 250 gpm. Ten-min cycle (6 starts) means 5-min withdrawal at 250 gpm, or total withdrawal of 1250 gal. 1250 gal is 30% of 4166 gal.

Answer: Use 4000 to 4200 gal tank. Pressure settings: start psi, 35, stop psi, 60. Set high level at 40% total tank capacity.

Dr Alexander G Christie, professor of mechanical engineering at Johns Hopkins University for the past 34 years, has been retired at the age limit. He will remain in Baltimore and devote more time to his consulting practice in the power-plant and industrial fields in this country and abroad. Recently, he was awarded the Lamme Gold Medal by American Society of Engineering Education for achievement in engineering teaching.

Allis-Chalmers has increased prices on electric motors, generators, motor-generator sets and electrical controls. This increase became effective July 6. An increase of 5% has been made in prices on certain electrical rotating apparatus, while price increase on controls is 10%. These changes follow a 5% increase on Allis-Chalmers' transformers, unit substations, feeder voltage regulators and switchgear, which became effective June 22.

Construction has been started on a new building to house the metallurgical, physical and chemical laboratories of Edward Valves, Inc, East Chicago, Ind., a subsidiary of Rockwell Mfg Co. The facilities will be used for research and development work on Edward and Nordstrom steel valves.

Foxboro Co, Foxboro, Mass., has conducted training courses in theory, application, operation and maintenance of industrial instruments since 1935. This year five courses, each of two weeks' duration have been arranged for July, Aug, Oct, Nov and Dec. Courses will also be arranged for companies who send a group sufficiently large to warrant a special class for study of particular instruments and applications. Also, special courses will be arranged for specific industry groups. Similar facilities are offered by Foxboro Co Ltd, in Montreal, for benefit of Canadian industry. Enrollment is by application, forms for which are available through all branch offices or from home office of the company, at Foxboro, Mass. Address director of training courses.

Dr Max Jakob, research professor of mechanical engineering at Illinois Institute of Technology and one of the world's foremost authorities on heat transfer, has been made an honorary doctor of engineering by Purdue University.

Kaye & MacDonald, Inc, West Orange, N. J., announces that it has purchased the Julian D'Este Div of American Chain & Cable Co.

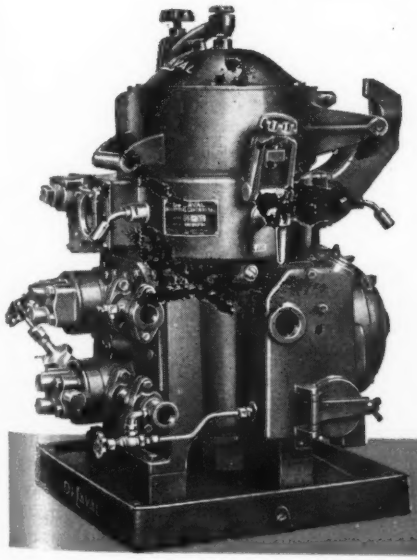
I DO TWO JOBS *at* ONE TIME

"I am De Laval Centrifugal Force. I keep lube oil—either turbine lube or Diesel lube—both ***clean*** and ***dry***.

"Being able to remove ***both*** contaminants of lube oil at one time gives me an advantage. It means that when I am on the job of protecting a power unit, the engineer never has any worries about dirt or condensate. Whether I am called on to remove a few drops of moisture or quickly to remove a dangerous "slug" of water, I can do it. De Laval machines, properly selected for capacity in the first place, have ample reserve capacity to take care of an emergency.

"When I purify Diesel fuel oil, I enable the operator to get maximum effective usefulness from his fuel oil.

"I'm written up in Bulletin 400 (Turbine Oil) and Bulletin DL-1 (Diesel Oil). Either will be sent on request."



THE DE LAVAL SEPARATOR COMPANY
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DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL

Lubricating Oil Purifiers

EXTRA POWER IN A SMALL MOTOR

means faster more thorough tube cleaning

AT LESS COST

Size for size, the Wilson ECT Series Air Motor will develop up to 40% more power than ordinary motors. That's why it can deliver maximum power at the most efficient cutter head speeds, *with less air consumption.*

The exclusive six-blade, light-bladed construction of the ECT Air Motor, together with automatic valving of operating air, assure maximum power from every cubic foot of air. 12 powerful impulses per revolution produce smoother flow of power—higher torque at any speed.

All this adds up to tube cleaning economy and lower air consumption. Whether you're cleaning water tubes or fire tubes a Wilson ECT Series Cleaner will mean faster cleaning for less down time, thorough cleaning for production savings.

For detailed information, write to Dept. M. TW-744

THOMAS C. WILSON, INC.
21-11 44th AVE., LONG ISLAND CITY 1, N. Y.
CABLE ADDRESS: "TUBECLEAN," NEW YORK

WILSON
TUBE CLEANERS

APPOINTMENTS

Allis-Chalmers Mfg Co has set up a sixth region for general machinery division's field organization under William Arthur. The new area, designated as Mid-Atlantic region with headquarters in Philadelphia, will embrace territory now covered by Philadelphia, Wilkes-Barre, Baltimore, York, Richmond and Charleston offices. The York and Charleston offices, managed by G E Conn and R L Halsted, respectively, formerly branch offices, become district offices under the regional plan. Frank Freyler succeeds Arthur as Philadelphia district office manager. W F Daly succeeds Freyler as manager of Cincinnati district office. P F Bauer has been named manager of newly formed central region of general machinery div, with headquarters in Cleveland. The new region embraces district office territories of Cleveland, Toledo, Pittsburgh, Youngstown, Wheeling, Cincinnati, Detroit, Grand Rapids and Jackson.

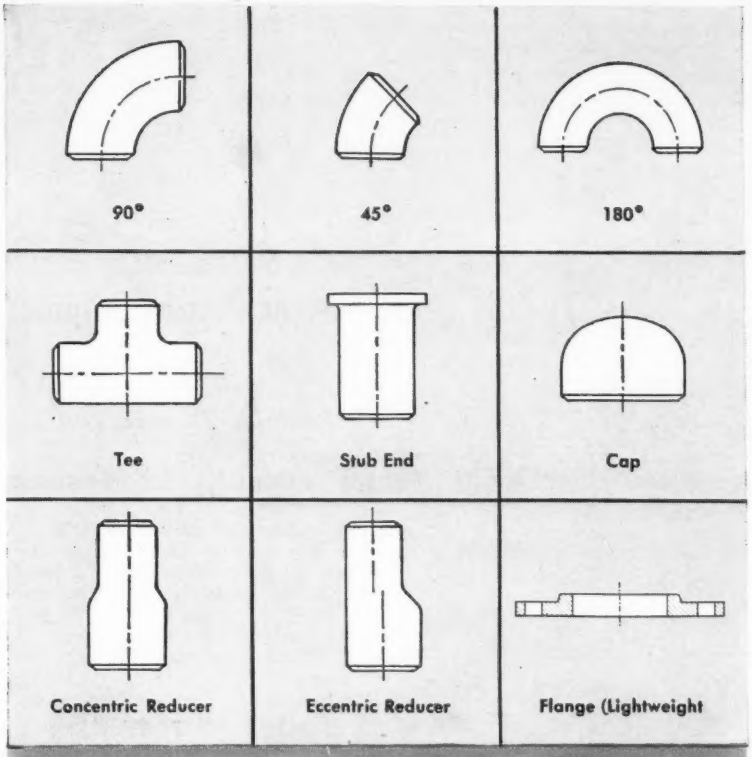
R N Miers has been made manager of sales section of **Allis-Chalmers'** steam turbine dept. Appointment of heads of three groups within sales section have been announced: (1) C W Bloedorn, turbines and turbine-generator units 10,000 kw and larger (2) W R Murley, turbines and turbine-generator units below 10,000 kw (3) Arthur Mergy, over-all studies and projects of a special nature not within scope of other two groups. G William Warner, for last 32 years chief inspector for Allis-Chalmers, retired July 15 after 50 years of service.

At a recent stockholders meeting, William H Rea was elected chairman of the board of **Detroit Stoker Company.** He was succeeded as president by William H Riecks. The following were also named: Wilfred S Thompson, Frederick B Strale, vice-presidents; Thatcher W Rea, secretary; and Sydnor M Broadus, treasurer. The above officers, with Royce L Beers and John D Campbell, constitute the board.

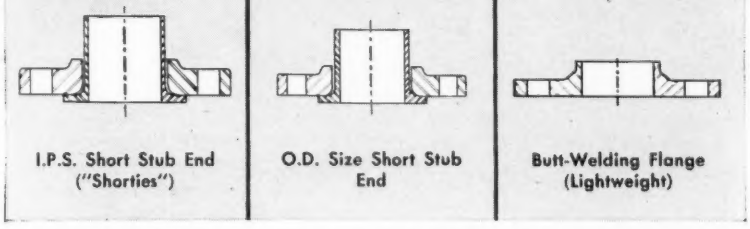
General Controls Co announces opening of a new and enlarged Denver factory branch office at 1162 Elati St, Denver 4, Colo., with M S Wilson as branch manager. Denver office serves Colo., Utah, Wyo., Mont., and parts of Idaho, N. M., Kan., Neb. and S. D. Mel W Lewis has been promoted to branch manager of Cleveland, Ohio factory branch office. Cleveland office serves most of Ohio, western N. Y., northwest Pa., southeast Ind. and central Ky.

Crozier S Wileman has been appointed district sales manager of **Link-Belt Co** at Wilkes-Barre, Pa., succeeding A C Williams who has retired after 43 years of service. Alton H Ziegler assists Wileman.

Brown Instrument Co announces another large increase in branch and regional sales and service staffs: (1) *Atlanta*: G L Ferguson as a sales engineer (2) *Baltimore*: Wayne Cook and Carl Lower as service engineers (3) *Boston*: Warren N Smith and Albert E Phillips as service engineers (4) *Charlotte*: W Williamson Jr as a service engineer and R J Holt as sales engineer (5) *Chicago*: Bernard Fuller and Ormond



A NEW SLANT ON FLANGED CONNECTIONS



Seamless stub ends for 10-S and 40-S piping with 150 lb. A.S.A. carbon steel lap joint flanges.

Seamless stub ends for O.D. tubing sizes with 150 lb. A.S.A. carbon steel lap joint flanges.

Lightweight stainless flanges (125 lb. American Standard diameter and drilling) for butt-welding to Schedule 10-S pipe.

TAYLOR FORGE WeldELLS and FLANGES

UNIFORMLY EXCELLENT

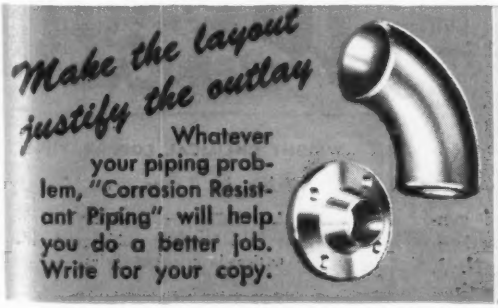
. . . . for conditions requiring:
Product Purity
Corrosion Resistance
Extremely High Temperatures
Extremely Low Temperatures
Maximum Economies

Available in Stainless 304, 316, 347, Monel, Inconel, Nickel, Copper; also other usual industrial metals.

Fitting sizes: ¾" through 12" and larger. Wall thicknesses: schedules 40S, 80S, 10S and others. Flange sizes: ¾" through 30" and larger.

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS General Offices & Works: Chicago 90, Ill. (P. O. Box 485) Eastern Plant: Carnegie, Pa.
District Offices—New York: 50 Church Street • Philadelphia: Broad Street Station Bldg. • Chicago District Sales: 208 S. LaSalle Street
Houston: City National Bank Bldg. • Los Angeles: Subway Terminal Bldg.


Make the layout justify the outlay
Whatever your piping problem, "Corrosion Resistant Piping" will help you do a better job. Write for your copy.

Send me "Corrosion Resistant Piping"

Name_____

Position_____

Company_____

Street Address_____

City_____ Zone_____ State_____

501-0948

Mail to Taylor Forge & Pipe Works
P. O. Box 485, Chicago 90, Illinois

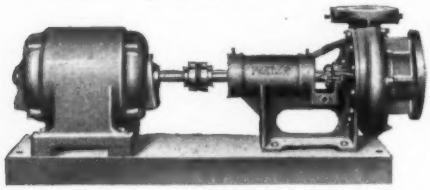
THE PEERLESS

Fluidyne

fmc PEERLESS PUMPS

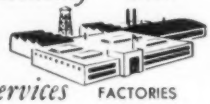
THE ALL-AROUND
ECONOMICAL GENERAL UTILITY
CENTRIFUGAL PUMP

HEADS: *Up to 270 feet*
DRIVES: *Fractional to 20 hp*
CAPACITIES: *Up to 1000 GPM*



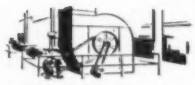
Type PB direct-connected to standard motor

Durability – Economy – Plus
Wide Utility for
a Multitude of Services



FACTORIES

The versatile Peerless Fluidyne is pumping simplicity at its best. Peerless FLUIDYNE Type PE (Electric drive unit) or the Type PB (direct connected, V-belt or flat belt drive unit) are designed for vertical, horizontal or intermediate angle installations, with consistent and dependable high efficiency operation. *Completely described in Bulletin B-165.*



SYSTEM SUBASSEMBLIES

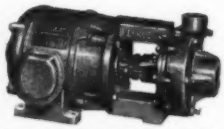
FLUIDYNE FRACTIONAL HP PUMPS ¼ TO 1 HP
CAPACITIES: *10 to 50 GPM*
HEADS: *20 to 95 ft.*

BUILDINGS

Possessing all characteristics of the Types PE and PB pumps described above, these fractional Fluidyne Peerless Pumps may be coupled to motor for incorporation into any system requiring forced liquid circulation. All Fluidyne pumps are of end suction, single stage

FOOD PACKERS

design with vertical split casing joint, and embody a host of features for ease of accessibility and maintenance. *Completely described in Bulletin B-150 and B-151.*



Type PE Integral HP Electric Unit

PEERLESS PUMP DIVISION

FOOD MACHINERY CORPORATION

Factories: Los Angeles 31, Calif.; Indianapolis, Ind.

District Offices: New York 5, 37 Wall Street; Chicago 40, 4554 No. Broadway; Atlanta Office: Rutland Building, Decatur, Georgia; Dallas 1, Texas; Fresno, California; Los Angeles 31, California

Herring as sales engineers (6) *Cleveland*: R Schumaker, sales engineer (7) *Denver*: Robert Koenig, service engineer (8) *Detroit*: W DeWolf, service engineer (9) *Dallas*: Robert Harris Jr, sales engineer (10) *Houston*: C D Walker, sales engineer (11) *Indianapolis*: Barry Coleman and Robert Thomas, service engineers (12) *Los Angeles*: Richard Corbin, service, and Ralph Imbrogno, sales (13) *New York City*: A Godfrey, sales, and Ernest P Lang, William C Meyer and Edward J Roach, service (14) *Philadelphia*: A L Rogers Jr, sales, and Albert T Collins, Joseph Facer and Edward A Lytle, service (15) *St. Louis*: Keith H Webb, service (16) *Syracuse*: Richard Caviniss and George Wilson, service (17) *Washington, D. C.*: John R Shea, service (18) *Kansas City*: D W Rees, service (19) *Omaha*: H C Klug, sales (20) *East Orange, N. J.*: William Harris, sales.

Dravo Corp has named Wilson C Blake Co, 190 Beacon St, Hartford, Conn., distributor of Dravo *Counterflo* heaters in Conn. and western Mass.

Paul Queneau has been made metallurgical engineer of **International Nickel Co of Canada, Ltd,** and subsidiaries. W K Sproule succeeds him as superintendent of research at Copper Cliff, Ont.

Peerless Pump Div, Food Machinery Corp, has announced sales personnel changes: (1) E E Bauer has been named manager of Peerless' central sales district at 4554 N Broadway, Chicago, Ill. (2) Frank W McCann has become centrifugal pump sectional sales manager for this div.

Harry W Beedle, manager Boston branch, **Electric Storage Battery Co,** retired on June 30 after more than 38 years of service in employ of Exide. Herbert H Warren has been made assistant manager, New York branch.

Infilco, Inc, has promoted A A Kalinske to director of development.

George W Smith Jr has been elected president of **De Laval Steam Turbine Co,** succeeding H L Watson who has retired.

Parker Appliance Co has appointed Charles E Cleminshaw chief industrial engineer.

Two additional Sales representatives for **L J Wing Mfg Co** in Canada have been named: J C Davis Ltd of Winnipeg will represent Wing in Manitoba, Saskatchewan and Alberta. Control Equipment Co of Toronto will represent Wing in Ontario. Preston, Phipps of Montreal will continue representation in province of Quebec, with manufacturing operations conducted from Montreal.

Ric-wil Co, of Cleveland, announces appointment of Edwin A Wert as vice-president in charge of engineering.

Russell E Ebersole has been named general manager of lamp sales for **Westinghouse Electric Corp,** Bloomfield, N. J. He succeeds William J Massey, who retired

CONTROL

Scale and Corrosion
in Power Plant Equipment
WITH
Newly Perfected
Water Conditioning Chemicals

Recently developed applications of the newer colloids and surface-active agents in Wright Chemicals for power plants result in improved water conditioning—**positive** scale and corrosion control. Wright Chemicals contain 100% soluble, available chemicals—no waste or inert matter—insuring increased operating efficiency and reduced cost.

Boiler Water . . .

Corrosion and scale-forming compounds in boiler water can be controlled with Wright Chemicals.

Steam and Condensate Lines . . .

Steam and condensate lines can be properly protected by using Wright recommended formulas.

Cooling Jackets . . .

Efficiency of cooling jackets can be substantially increased by preventing corrosion and scale deposits on heat transfer surfaces.

Wright improved chemicals are the result of intensive study and research by men with years of experience in the development, production, application and control of water-conditioning chemicals.

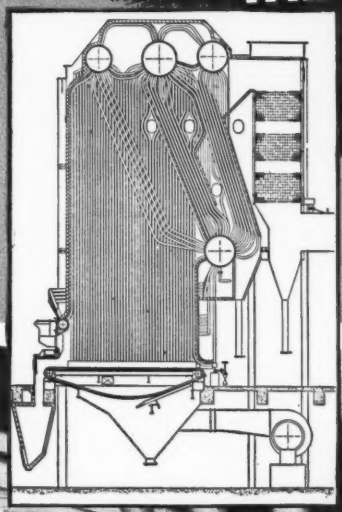
Wright has no one cure-all to solve all problems. Each receives individual treatment. The Wright field engineer, who will call on you upon request, will obtain all necessary information and samples for examination in the modern Wright laboratory. Analyses are interpreted in view of supplemental information received, and recommendations made in the form of a proposal. Clients are provided with regular laboratory service as a periodic check upon conditions.

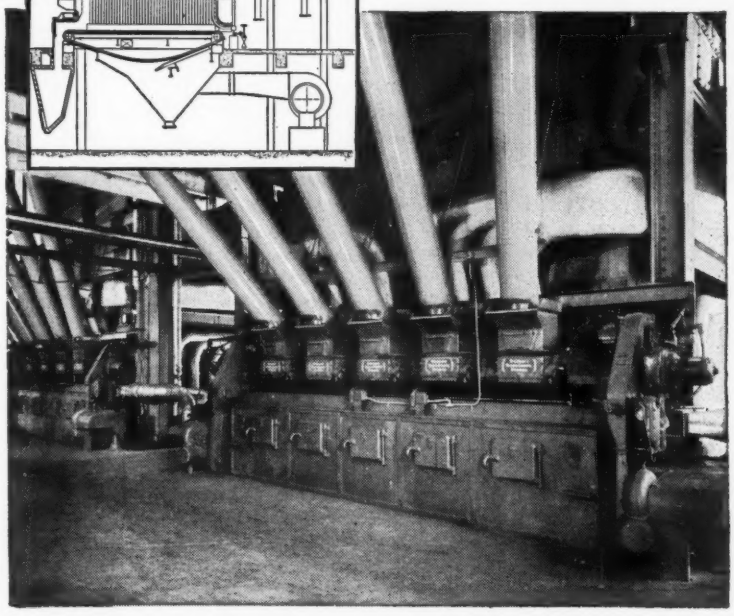
There is a Wright Field Engineer near you, anxious to help solve your scale and corrosion problems. No obligation.

Wright CHEMICALS

WRIGHT CHEMICAL CORPORATION
Specializing in Water Conditioning
GENERAL OFFICES AND LABORATORIES
617 West Lake Street Chicago 6, Ill.
Offices in Principal Cities

DETROIT ROTOGRATE STOKERS Will Cut the Cost of Producing Steam In These Paper Mills





150,000 pound units with Detroit RotoGrate Stokers—Consolidated Paper Company, South Side Plant, Monroe, Michigan.

Fuel economy and recognized ability to handle high capacities and widely fluctuating loads has made the Detroit RotoGrate Stoker popular with Paper Mills.

A spreader type with grates that move slowly *forward* to *continuously discharge the ash at the front*. Successfully burns all grades of coal and Lignites. No special fuel preparation necessary.

Backed by over ten years' experience building Detroit RotoGrate Stokers. Our Engineering Department at your service—no obligation. Write for Bulletin.

Recent Orders:

American Box Board Co.
Grand Rapids, Mich. (Two Contracts)
Appleton Coated Paper Co.
Appleton, Wisconsin
Chillicothe Paper Co.
Chillocothe, Ohio
Consolidated Paper Co.
Monroe, Michigan (Two Contracts)
Flambeau Paper Company
Park Falls, Wis.
Fletcher Paper Company
Alpena, Michigan
The Great Northern Paper Co.
Millinocket, Maine
Hoberg Paper Mills, Inc.
Green Bay, Wisconsin
International Paper Co.
Panama City, Fla.
Manitoba Paper Co. Ltd.
Pine Falls, Manitoba
Michigan Carton Company
Battle Creek, Mich.
Michigan Paper Company
Plainwell, Michigan
Northwest Paper Company
Cloquet, Minnesota (Two Contracts)
Rex Paper Company
Kalamazoo, Michigan
River Raisin Paper Co.
Monroe, Michigan
Schmidt & Ault Paper Co.
York, Pennsylvania
Sutherland Paper Company
Kalamazoo, Michigan
Thilmany Pulp & Paper Co.
Kaukauna, Wisconsin
West Virginia Pulp & Paper Co.
(Two Contracts)
Charleston, S. C. and Covington, Va.

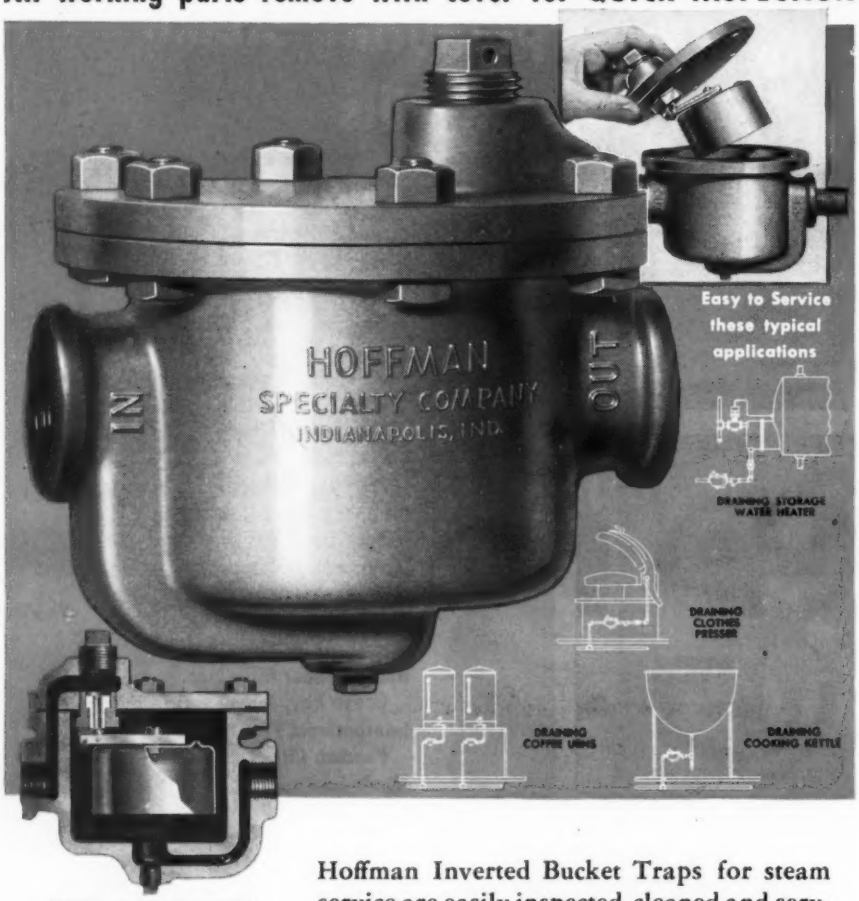
DETROIT STOKER COMPANY

GENERAL MOTORS BUILDING, DETROIT 2, MICHIGAN

WORKS AT MONROE, MICHIGAN • DISTRICT OFFICES IN PRINCIPAL CITIES

Serviceability...

All working parts remove with cover for QUICK INSPECTION



Simple mechanism provides high operating efficiency

Hoffman Inverted Bucket Traps for steam service are easily inspected, cleaned and serviced by merely removing the cover assembly.

All that is necessary is to take out the bolts, lift up the cover, and all working parts are right in your hand. To drain trap body, simply remove bottom plug. Easy as A • B • C.

These are features of design appreciated by the maintenance man in saving man-hours when manpower is costly and scarce.

Hoffman Bucket Traps are adjustable to a wide choice of pressures — simply by changing valve seats. Available for steam pressures up to 200 lbs. —capacities to 4450 lbs. of water per hour.

NOW AVAILABLE
The 600A
Inverted Bucket Trap

½" x ¾" sizes; for pressure differentials from 5 lbs. to 125 lbs. per sq. in. and capacities from 600 to 1150 pounds water per hour. Just the combination you have wanted for a multitude of applications.

HOFFMAN
INVERTED BUCKET TRAPS
FOR STEAM SERVICE

HOFFMAN SPECIALTY CO., 1001 YORK ST., DEPT. P-9. INDIANAPOLIS 7, IND.
Makers of Valves, Traps, Vacuum and Condensation Pumps, Forced Hot Water Heating Systems.

after 50 years with the lamp div. Harold G Cheney has been made assistant manager of lamp sales. Romus Soucek has become sales manager of aviation gas turbine div at South Philadelphia, Pa.

John H Matthews, vice-president and director of **Raybestos-Manhattan, Inc,** has been elected to board of directors of Canadian Raybestos Co, Ltd. Matthews is in charge of Manhattan Rubber Div at Passaic, N. J. A L Hawk has been made assistant to western district manager in Chicago and R B Hazard manager of distributor sales, western district, for Manhattan Rubber Div.

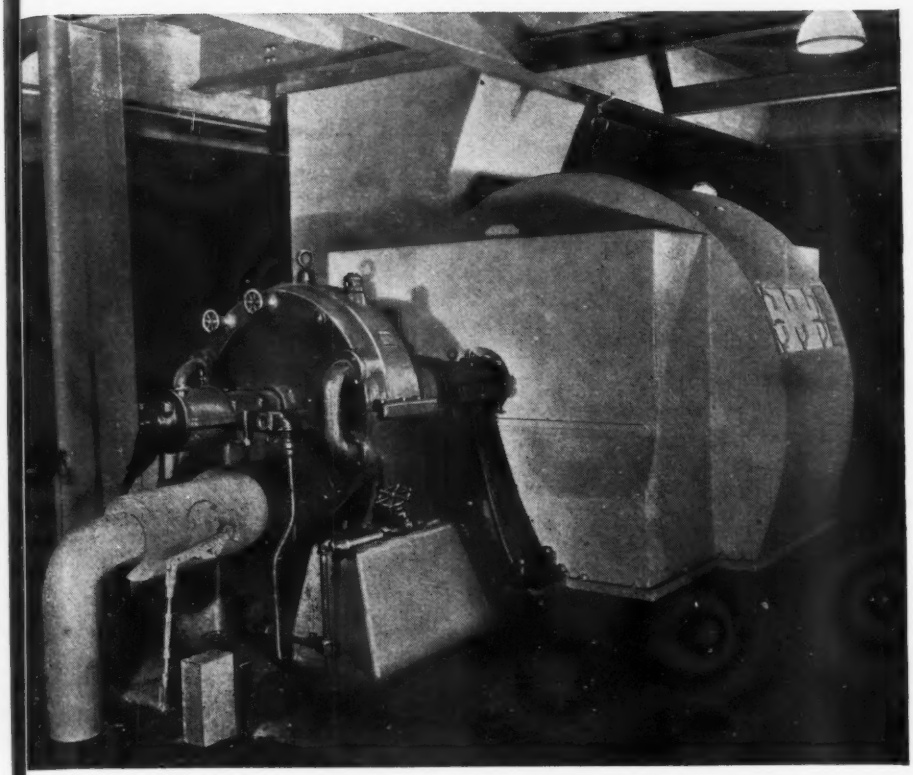
Harlan T Pierpont Jr has been made sales manager, refractories div of **Norton Co.** He succeeds Robert Kirkpatrick, who has retired. Norman V Crabtree has been assigned as abrasive engineer in Mich. Richard H Merchant has been appointed abrasive engineer in Detroit and assumes responsibility for Crabtree's area. Murner E Thor has become refractories engineer of refractories div. He will cover Canadian and New England territories formerly handled by E A Fischer. Thor's headquarters will be in Worcester. Fischer transfers to refractories sales engineering dept as sales engineer.

Arnold H Smith has been elected president of **Monsanto (Canada), Ltd,** with offices in Montreal. Leo G Ryan remains as chairman of board. L E Ryan has been made first vice-president of the company. He remains in charge of manufacturing and development programs of the Canadian organization.

Continental Foundry & Machine Co has purchased Vulcan Soot Blower Corp, DuBois, Pa., and Northern Equipment Co, Erie, Pa. New officers and directors of Vulcan are: (1) George L Davis, president (2) D E Hibner, vice-president (3) W N McCreight, secretary (4) Arthur Kuiper and William B Todd, directors. Other management is the same as formerly and all business activities continue to center in DuBois. Present management of Northern Equipment Co remains and includes following officers and directors: (1) E W Nick, president (2) V V Vennschoten, vice-president (3) William L Hunter, general manager (4) George L Davis, Arthur Kuiper and William B Todd, directors.

General Electric Co has elected R I Parker a commercial vice-president. Parker succeeds W O Batchelder, who retired after 43 years of service. With headquarters at Chicago, Parker will have charge of customer relations in Ill., Mich., Wis., Minn., Iowa, eastern Neb., Kan., Mo and western Tenn. T B Ellis has been appointed central district manager of apparatus dept. The central district, with headquarters in Chicago, covers Ill., Mich., Wis., Minn., N. D., Iowa, Kan., Mo., and parts of S. D., Neb., Mont., Ark., Tenn. and Ind. Direct sales and service facilities for GE arc welders, electrodes and welding accessories are now available to industry at General Electric's Fitchburg, Mass, plant. The new service is under direction of Roger W Wenzel, recently appointed sales representa-

AIR EQUIPMENT TO HELP YOUR BUSINESS



"Buffalo" Induced Draft Fans combine high efficiency with long life on the job

FEWER DRAFT TIMEOUTS *mean* CHEAPER POWER PRODUCTION

THIS is the principle on which "Buffalo" builds mechanical draft fans. With many boilers operating at 400% of capacity and more, reliable draft fan performance makes a big difference in power output. Thus, the extra heavy construction we put into "Buffalo" Draft Fans has paid off in hundreds of installations in LONGER SERVICE WITHOUT SHUTDOWNS—and, invariably, LOWER POWER PRODUCING COSTS in the long run.

Write for Bulletins 3113-A and 3190-B—see these construction details that add up to longer life on your draft job.

BUFFALO FORGE COMPANY

488 BROADWAY BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Branch Offices in All Principal Cities

FANS by "Buffalo"

EQUIPMENT FOR

- ★ VENTILATING
- ★ HEATING
- ★ COMFORT COOLING
- ★ PROCESS COOLING
- ★ AIR TEMPERING
- ★ AIR WASHING
- ★ EXHAUSTING
- ★ BLOWING
- ★ FORCED DRAFT
- ★ INDUCED DRAFT
- ★ PRESSURE BLOWING
- ★ CLEANING
- ★ DRYING

CUTTING AIR COSTS IN EVERY BRANCH OF INDUSTRY

ALLPAX

. . . the PACKING that packs ALL

ALLPAX is the *universal* packing for general service . . . for all stuffing boxes of any size or shape . . . for steam, water, air ammonia, oils, gases, distillates, etc., where temperature does not exceed 600F.

With ALLPAX there is no necessity to keep on hand a special packing for this or that use. You can standardize on ALLPAX for *all general purpose uses* and be assured of long-lived, economical service wherever it is used.

ALLPAX is a combination of long, tough fibres of asbestos, thin flakes of highest grade anti-friction metal, minute flakes of graphite, and a special non-liquid heat-proof lubricant, compounded to assure long-wearing, leak-proof, non-scoring packing for severe service. Its low friction cuts down power losses and improves efficiency.

Special styles available for special service.

Try ALLPAX once and you'll use it always. Distributors everywhere.

THE ALLPAX COMPANY, INC.

Mamaroneck, New York

No Waterlogging or Air Binding in HYDRO-PNEUMATIC TANKS EQUIPPED

with **DUOTROL**

The DUOTROL maintains high water level at a fixed point and correctly balances air pressure after each pumping operation. It provides a maximum volume of water with a minimum of pump operation, saving power and reducing wear. Easy to install, stable adjustments.

The DUOTROL shown is on a tank where water at 50°F is pumped from a 600 ft. well for summer cooling of a complete shopping center. The pressure range is from 30 to 70 lbs.

Ask for Bulletin D-6.

"AUTOMATIC" also makes pressure and float operated pump controls: multi-circuit sequence type, multi-circuit program type, float switches, automatic alternators, and many special controls built to specifications.

AUTOMATIC CONTROL Company

1009 UNIVERSITY AVE., ST. PAUL 4, MINN.

AUTOMATIC CONTROL are used by all leading pump manufacturers. When ordering new pumps, specify controls by AUTOMATIC CONTROL CO.

tive of welding equipment divisions for central and western Mass. and states of Me., Vt. and N. H. Robert W Jackson, on transfer from GE's general news bureau, Schenectady, N. Y., replaces F Lowell Garrison as western representative in advertising and publicity at San Francisco for GE.

Raymond G Schieleas has been appointed buyer for resin and insulation materials div of General Electric Co. Dr Zay Jeffries, vice-president, announces appointment of George P Lehmann to his personal staff with duties as assigned. Robert L Gibson succeeds him as manager of plastics div, which has plants in Meriden, Conn.; Taunton, Mass.; Pittsfield, Mass.; Scranton, Pa.; Coshocton, Ohio; and Decatur, Ill. Harold F Smiddy has been named general manager of chemical dept. His headquarters will be in Pittsfield, Mass. Roger W Jackson has been appointed district sales manager of chemical dept's east central district, with headquarters in Cleveland, Ohio. George Alexander has been made assistant to manager of laminated plastics plant in Coshocton, Ohio. He will be in charge of Coshocton Works' new varnish plant. Edward G Gray has been appointed work engineer of laminated plastics plant in Coshocton.

Dearborn Chemical Co has assigned F E Rolston to territory previously covered by Tom Holcombe. Rolston will cover La., Ark. and part of eastern Texas. He will be in charge of sale of all Dearborn products and will be temporarily located at Shreveport office.

F L Murdock and Co, Tulsa, Okla., has been appointed to handle **Hewitt Rubber Div** line as industrial and oil field distributors of hose, conveyor and transmission belting, and packing.

Island Equipment Corp, with general offices at 27-01 Bridge Plaza North, Long Island City 1, N. Y., are opening a branch office at 2205 Washington St, Newton Lower Falls 52, Mass. Denny Bohn has been placed in charge of this office, with John Durkee as assistant.

Arthur E Currier has joined research dept of **Harbison-Walker Refractories Co,** Pittsburgh, Pa.

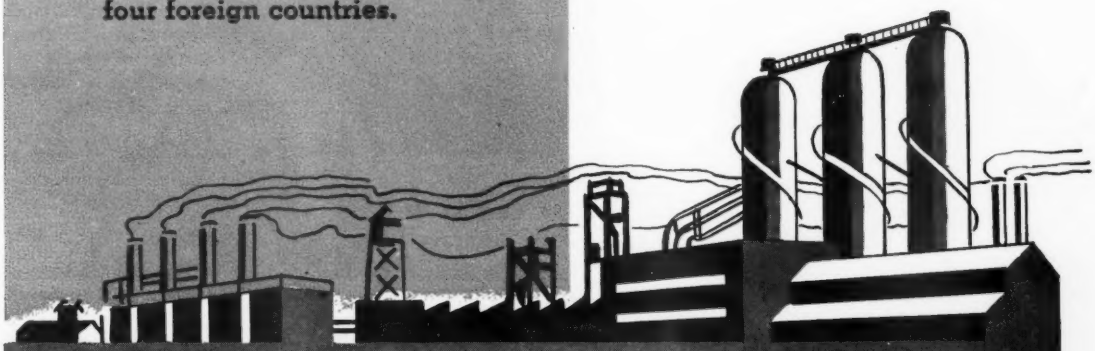
Lima-Hamilton Corp has appointed C B Murphy to represent the firm in sale of diesel engines and power engineering equipment in the Southwest. His headquarters will be at 3130 Daniels St, Dallas.

John G Seiler has been elected executive vice-president of **Tube-Turns, Inc,** Louisville, Ky.

A Ray MacPherson has joined **Thermoid Co** as manager of its industrial friction materials sales div. MacPherson will make his headquarters in Detroit, Mich.

Tube-Turns, Inc, has acquired Pennsylvania Forge Corp. George O Boomer, president of Tube-Turns, and its affiliate Girdler Corp, will be chairman of board of the Pennsylvania firm. James S Kerwin, presi-

The Shaw Company has a total of 3,000 employees working in ten States and in four foreign countries.



WHATEVER YOUR PIPING NEEDS

SHAW

FILLS THEM QUICKLY • DEPENDABLY

Benjamin F. Shaw Company is qualified to pre-fabricate and erect piping throughout the world.

PRESIDENT

BENJAMIN F. SHAW COMPANY
2ND & LOMBARD STS. • WILMINGTON 99, DELAWARE

KNOWN SINCE 1893 FOR HIGH-QUALITY PIPING PRE-FABRICATION AND INSTALLATION

Extra STRENGTH for Heavy Duty

KEWANEE

• Extra stout stays and braces add further strength to the sturdy steel construction.

10 to 304 H. P.

100, 125, 150 lbs. W. P.

Has all the characteristics which make firebox boilers especially adapted for high pressure.

WON FOR 5th TIME

75 Years Boilermakers

For 6" scale with pipe diameter markings... WRITE Dept. 96-K9

KEWANEE BOILER CORPORATION
KEWANEE, ILLINOIS

IT COSTS NO MORE TO HAVE THE BEST . . .

Corning Mill Supply Glassware

The same glass that is used in making Corning's famous PYREX brand laboratory glassware goes into the manufacture of PYREX brand gauge glasses, sight glasses, oil cup and lubricator glasses. It is positive assurance of top quality. It means longer resistance to etching, staining, pitting and scratching . . . which means low cost.

A LINE THAT ANSWERS ALL REQUIREMENTS

GAUGE GLASSES: PYREX and CORNING brand tubular gauge glasses and MACBETH brand flat gauge glasses provide good visibility over prolonged periods, even under severe conditions (pressures up to 2,000 p.s.i., depending on type).

SIGHT GLASSES: PYREX brand sight glasses are made especially for ovens, absorption columns, reaction kettles, furnaces, pressure vessels, stills, tanks (pressures up to 300 p.s.i.).

OIL CUP AND LUBRICATOR GLASSES: PYREX brand glassware gives you visibility plus long life.

CORNING GLASS WORKS • CORNING, N. Y.
Sales Offices: New York, Chicago, San Francisco

PYREX GAUGE GLASSES
BRAND

CORNING GLASS

CORNING GLASS WORKS, Dept. 03-79P, CORNING, N. Y.

We are interested in buying .....
Where is nearest source of supply?
Name .....
Company .....
Address .....
City ..... *Zone* ..... *State* .....

TECHNICAL PRODUCTS DIVISION: GAUGE GLASSES • GLASS PIPE • LIGHTINGWARE
SIGNALWARE • LABORATORY GLASSWARE • OPTICAL GLASS • GLASS COMPONENTS

dent, and W T J Huggard, secretary and treasurer, and other officers, will continue in their present capacities. There will be no change in personnel of the various departments. Business of the new subsidiary will continue to be operated under name of Pennsylvania Forge Corp.

Danforth K Heiple has been promoted to chief field engineer for **R G LeTourneau, Inc.** Heiple will give sales assistance to LeTourneau distributors in planning equipment applications and compilation of earthmoving production and cost. He succeeds R C Lewis, resigned.

Marley Co announces opening of a new district office in Philadelphia at 1112 Packard Bldg. Robert M Sharp is in charge.

Kalstad Engrg & Sales Co, 38 Giralda Walk, Long Beach 3, Calif., has been appointed sales representative for **Thomas C Wilson, Inc,** Long Island City, N. Y. The new agent will handle Wilson products in southern Calif. area.

American Brake Shoe Co has named Gilfry Ward vice-president of Kellogg div. He will continue to be located in Oakland, Calif.

Carl W Volz has been elected a vice-president of **Electro Metallurgical Co,** a unit of Union Carbide and Carbon Corp.

G L Ferguson of **Brown Instrument div,** Minneapolis Honeywell Regulator Co, has been transferred from Atlanta to Charlotte office.

C Lee Cook Mfg Co, Louisville, Ky., has appointed Marion A Boulden to its sales-engineering staff. He will eventually make his headquarters at Charleston, W. Va., and will serve the natural gas, chemical, steel and associated industries in W. Va., western Pa., southern Ohio, and eastern Ky.

Walter B Gallagher has been made sales manager of **Greene, Tweed & Co.,** North Wales, Pa. Gallagher succeeds Howard Josephson, who resigned.

Bailey Meter Co has promoted H T Sawyer to manager of its larger Buffalo office, replacing S W Nelson, deceased. K E Atwood has been appointed Seattle office manager, replacing Sawyer. Bailey Meter also announces following branch office assignments: (1) R E Erickson to Philadelphia office (2) F J Ghezzi to Schenectady office (3) F D Krusemark to Denver office (4) J R Brennan to Buffalo (5) R R Beal and D A Gearhart to St. Paul office (6) A Martin to Atlanta office. These graduate engineers are available to advise and assist power and process engineers in proper application of measuring and controlling instruments.

William E Corrigan, vice-president of **American Locomotive Co,** has been placed in charge of sales of the locomotive div, including direction of all sales activities of district sales offices. He will have offices in Schenectady, N. Y., in line with the company's policy of moving its general

ANOTHER

COPPUS

"BLUE RIBBON" PRODUCT

Prevent Idle Horsepower

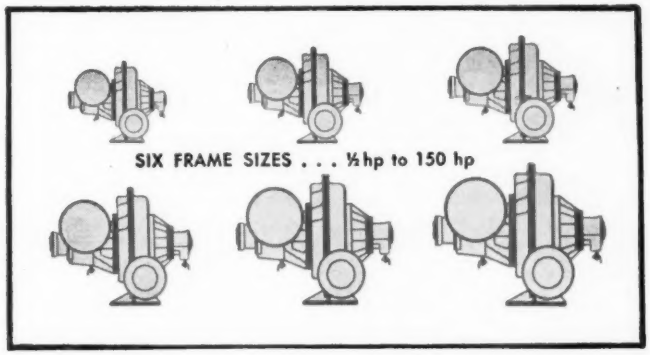
FROM EATING INTO YOUR PROFITS

Paying for a larger turbine than you need is a waste of money you can easily avoid. Coppus "Blue Ribbon" Turbines are designed to meet small-power requirements exactly. Made in six frame sizes — fractional to 150 hp, and priced accordingly — they're hard-working, smooth-running, always dependable... the logical, economical drives for your pumps, blowers, fans and similar equipment.

Coppus precision-builds these rugged performers, checks their close tolerances with Johansson blocks, gives each a thorough dynamometer test before shipment. That's why you can count on them for the cost-saving efficiency built into all Coppus "Blue Ribbon" products — blowers, ventilators, gas burners, etc.

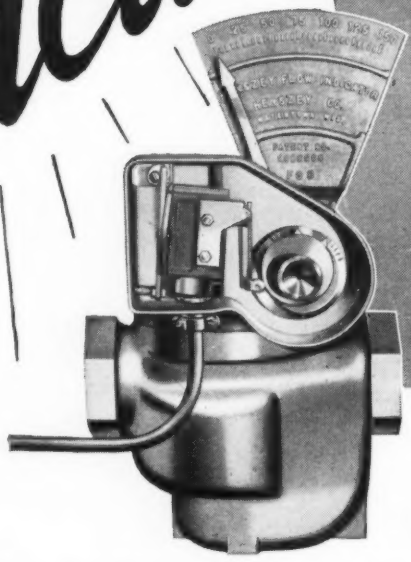
Since 1937, over 85% of all orders for Coppus Turbines have been repeat orders. Add their rapidly increasing use on top-name original equipment and you have conclusive proof of their ability to make good on the job — *your* job.

Send for Bulletin 135-10 COPPUS ENGINEERING CORPORATION, 169 Park Avenue, Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG.



New!

SOUNDS the alarm at HIGH or LOW FLOW

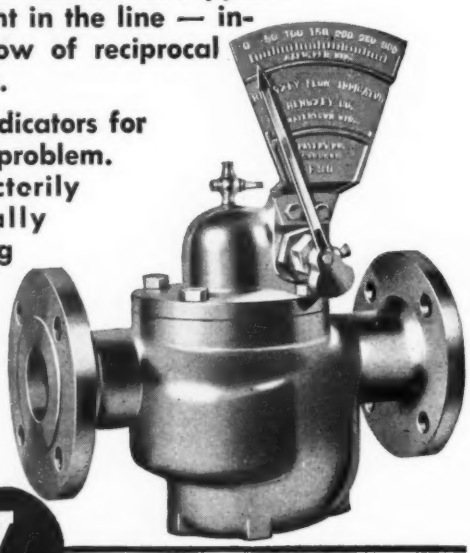


HENSZEY *Flow* INDICATORS

Operators are immediately warned against too high or too low rates of liquid flow with this new electric alarm system built on the standard Henszey Flow Indicator. Pointers may be set for sensitive alarm control within a fraction of a gallon per minute . . . or at the widest range limits.

There are only three moving parts in the Henszey Flow Indicator — no breakdowns due to complicated gears and mechanisms. No additional supports are needed — it goes right in the line — indicating the pulsating flow of reciprocal pumps exactly as it occurs.

Consider Henszey Flow Indicators for your tough rate-of-flow problem. Installations are satisfactorily performing in nationally known manufacturing plants of all kinds. Send for bulletin FI-1.



HENSZEY COMPANY
Department D9
Watertown • Wisconsin

HENSZEY

FLOW INDICATORS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Boiler Feed Regulators • Proportioning Valves
also MILK EVAPORATORS and PRE-HEATERS

offices from New York to Schenectady. Corrigan will also maintain an office in New York City. The office of vice-president of eastern regional sales, formerly held by Corrigan, has been abolished.

Crocker-Wheeler Electric Mfg Co, Ampere, N. J., div of Joshua Hendy Corp, has appointed Ralph S Drummond manager of Cincinnati Crocker-Wheeler branch office.

E B Newill has been elected a vice-president of **General Motors Corp.** His headquarters are in Indianapolis, Ind.

De Laval Steam Turbine Co has announced retirement of H L Watson as president after 35 years of service. George W Smith Jr has been elected as his successor. Watson will continue to be part of the company's management in capacities of a director and chairman of executive committee. L D Litsey has been made Chicago area representative for worm gear speed reducers. Headquarters for Litsey are at Litsey Equipment Co, 6459 N Sheridan Rd, Chicago 26, Ill. Other De Laval products will continue to be handled by Chicago district office of De Laval at Peoples Gas Bldg, Chicago 3, Ill.

Herman E Warren Jr has been appointed to represent the valve div of **American Car & Foundry Co,** with headquarters in Atlanta, Ga. He will cover all industrial fields in the territory.

Rockbestos Products Corp has made following changes in district sales offices: (1) H B Hammond has been relieved of his duties as district manager of New York office to devote himself exclusively to servicing of all departments of Federal Government in Washington, D. C., and all private shipyards on East Coast. His business address will be at company headquarters in New Haven, Conn. (2) J T Williams has been advanced to New York office as district manager. (3) D S Lee has been transferred to Cleveland office as district manager and Buffalo district was incorporated in the Cleveland office territory. (4) S A Sargent has been transferred to Chicago district office. (5) R G Newton has been made district representative of New England territory, with headquarters in New Haven.

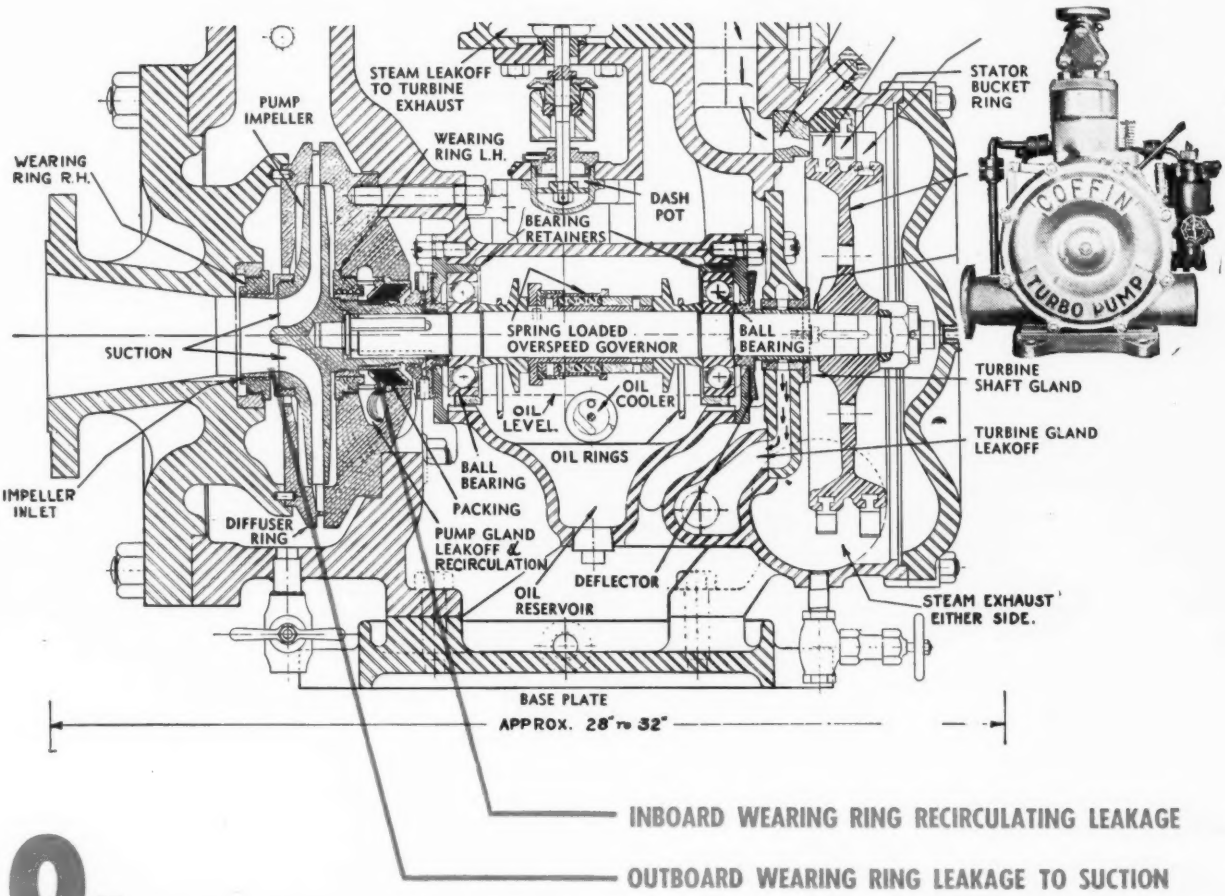
Benson Reark has been named factory superintendent of **Potter & Brumfield** of Princeton, Ind.

Worthington Pump and Machinery Corp announces appointment of Harold T Anderson as assistant to general sales manager, in charge of sales production relations, with headquarters at Harrison (N. J.) Works. Anderson is responsible for receiving and interviewing representatives of customers' organizations who visit Harrison Works seeking current information with respect to production schedules of specific orders.

Elliott Co, Jeannette, Pa., announces assignment of A W Wood as field engineer in Detroit district office. L B Rahn has been made field engineer to New York district office. Following graduate engineers have

COFFIN TURBO PUMPS

HIGH SPEED • SINGLE STAGE



9- Integral Recirculation System

The essential leakage past the inboard wearing rings is piped back to the suction reservoir (feed tank). Thus excessive pressure is not imposed on the pump gland and the recirculation effected is sufficient to permit operation without overheating or "flashing" for indefinite periods with the pump discharge shut off. Extra load on the pump and automatic or manual recirculating valves are eliminated.

Standardized Boiler Feed Units for:

Steam Pressures to 650 PSI
Steam Temperatures to 850 F
Back Pressures to 60 PSI

Pump Capacities to 500 GPM
Discharge Pressures to 750 PSI
(Heads to 1800 feet)
Liquid Temperatures to 300 F

UNIQUE FEATURES

1. Standardized Steam Turbine Centrifugal Pump and Governor Sets, individually engineered, assembled, and tested . . for IMMEDIATE SHIPMENT.
2. No destructive casing erosion-corrosion.
3. No interstage leakage.
4. Wide range exact pressure governing.
5. Loss of suction reduces speed without tripping; automatic speed recovery with suction restoration.
6. High efficiency pump plus high speed two-bucket row turbine result in minimum steam consumption.
7. Matched Pump, Turbine and Governors under one responsibility.
8. Exact hydraulic and mechanical balance—light weight rotor—large bearings; result: bearing troubles practically unknown.
9. Pump Gland Leakoff provides adequate recirculation; suction pressure only on packing.
10. Rigid one-piece steel casing plus heavy shaft plus ample clearances result in no damage from dry operation.
11. All parts made to gage and replaceable without fitting; all parts in stock at factory with wearing parts available from agencies' stocks.
12. Proved for performance over a period of more than twenty years in service.
13. Compact, light in weight, quiet and low in maintenance.

Literature sent on request; specific proposals on receipt of operating date.

See our Catalog in Sweet's Power Plant and Engineering Files

INDUSTRIAL RAILROAD COFFIN MARINE PRODUCTS FOUNDED 1925

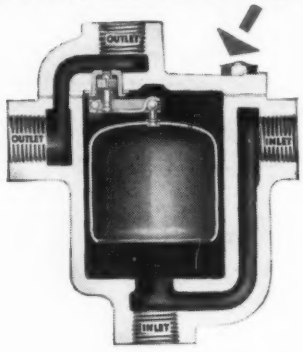
The J.S. COFFIN, JR., CO. 328 South Dean St. ENGLEWOOD, N.J.

CHOOSE CLARK
All down the line

A NEW TRAP
JOINS A
FAMOUS LINE

Clark Traps

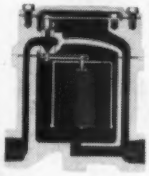
INTRODUCING THE NEW CLARK "60"



Series "80"
Inverted Bucket
Steam Trap

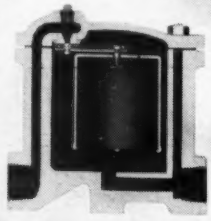
"CRV"
Pressure
Regulator

A small trap with big trap features. Positive seating with guided disc. Equipped with *two inlets* and *two outlets* for easy installation for horizontal, vertical or angle connections.



Let Clark's 40 years of experience be your guide in selecting the proper trap or valve for your drainage needs.

Series "70-T"
Inverted Bucket and
Blast Steam Trap



Clark

Write today for complete story on Clark Traps and Valves.

THE CLARK MANUFACTURING CO.
1831 EAST 38th STREET • CLEVELAND 14, OHIO

Series "70"
Inverted Bucket
Steam Trap

Clark

TRAPS — FLOAT, INVERTED BUCKET, OPEN BUCKET AND VACUUM • REDUCING VALVES • STRAINERS

been assigned to district offices upon their completion of a one-year training course: F C Hohenstein, Chicago; M C Seeman, Cleveland; G J Greaney Jr, Houston; J U Kauffman, St. Louis, Mo.; R L Henry, Tulsa; and W W Gotherman to Washington, D. C.

William W Hickey now represents **Flexible Steel Lacing Co** in New England and New York territory. He succeeds John Ramsey, who has been transferred to executive sales office in Chicago.

E L Behrends has joined general sales dept of **Taylor Forge & Pipe Works,** which operates plants at Chicago and Carnegie, Pa.

Establishment of a new manufacturer's representative organization is announced with formation of **Clifford B Ives & Co** in Philadelphia. This company has been selected by Fisher Governor Co, Continental Equipment Co, Daniel Orifice Fitting Co and others to represent them in eastern Pa., southern N. J. and Del. Offices are maintained at 1500 Walnut St, Philadelphia.

Philadelphia Electric Co has named Lewis R Gaty manager of engineering dept, succeeding K M Irwin, who was recently elected vice-president in charge of engineering. J A Purcell has been appointed division manager of newly created western div. His headquarters will be at Coatesville.

Thomas H Burton has retired from **Boston Edison Co** after about 32 years of service. Burton's successor is C R Irving, acting chief, and H E Stickle has been promoted to assistant acting chief engineer.

Merrill W Allen, boiler inspector for Worcester area for **Massachusetts dept of public safety,** has retired from active service.

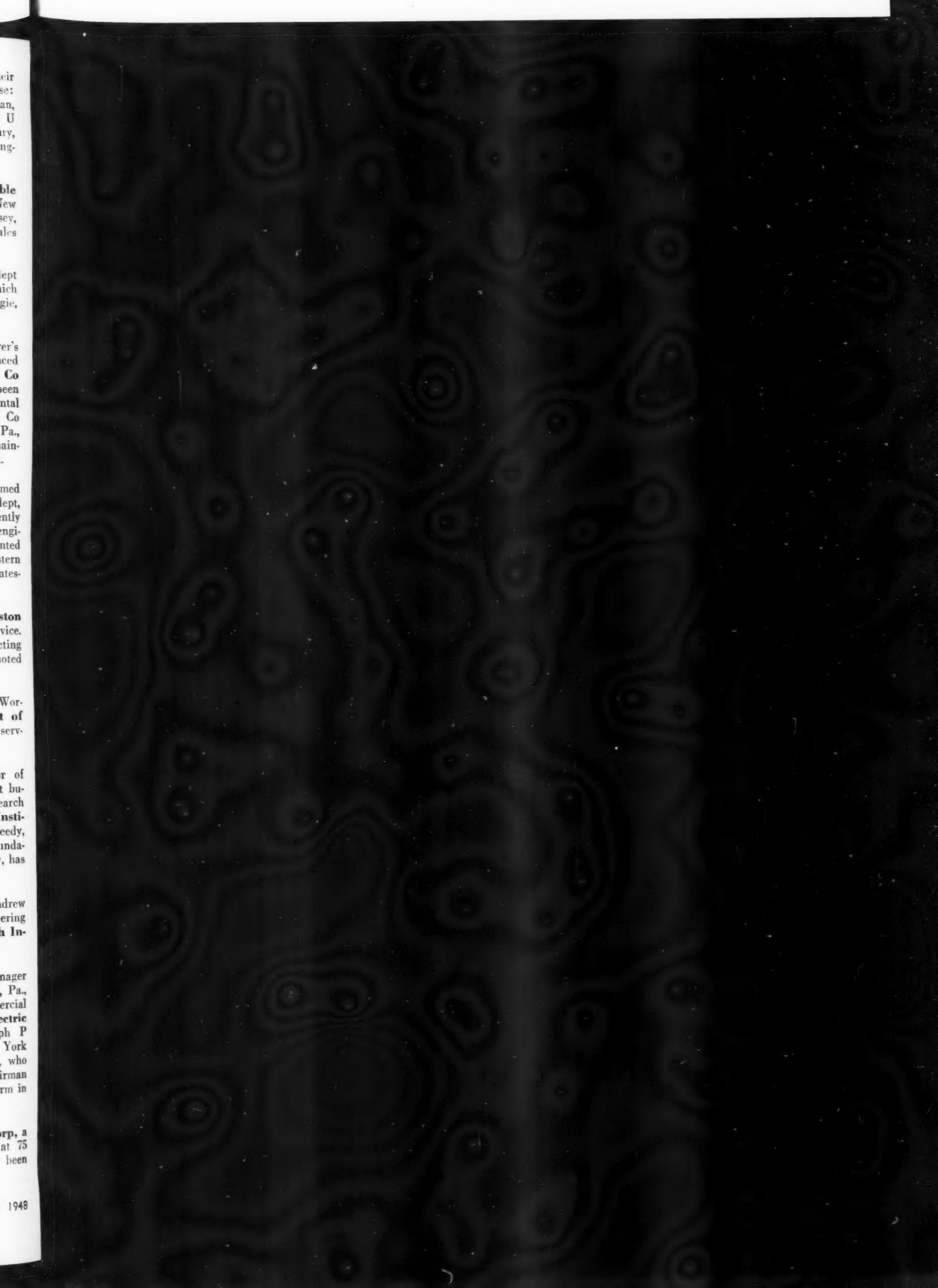
Alexander W Wundheiler, supervisor of ordnance research in U. S. Navy dept bureau of ordnance, has been named research professor of mechanics at **Illinois Institute of Technology.** Dr Haldon A Leedy, acting director of Armor Research Foundation of Illinois Institute of Technology, has been named director.

Carl C Perkins Jr, Leo Shapiro and Andrew Davis St. John have joined the engineering mechanics staff of **Midwest Research Institute.**

Harry Restofski, sales promotion manager of West Penn Power Co, Pittsburgh, Pa., has been appointed chairman of commercial div general committee of **Edison Electric Institute.** Restofski succeeds Ralph P Wagner, commercial manager of New York Power & Light Corp, Albany, N. Y., who has been commercial division chairman since 1946. He will serve a 2-year term in this office.

Chemical Pump & Equipment Corp, a new sales organization with offices at 75 West St, New York 6, N. Y., has been

(*Continued on page* 190)



Reader Service Page for . . .

NEW EQUIPMENT and TECHNICAL LITERATURE

Use the handy FREE service cards for additional information on this month's new products or for copies of latest trade catalogs.

NEW PRODUCTS & MATERIALS

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Portable Boiler ..... page 112
Axial-Flow Pump ..... page 112
Electronic Control ..... page 112
Check Valve ..... page 112
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Adjustable-Pitch Sheaves ..... page 114
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Plug-In Panelboard ..... page 146
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Nylon V-Belts ..... page 148

HOW TO ORDER ADDITIONAL DATA

Be sure to fill out, completely, one coupon for each item of information you order. (See sample, right.) This gives your request authority and helps the manufacturer to address your copy completely.

When you have filled out completely one space for each item of information you want, detach along the scored lines and drop the cards in the mail.

Example

Write here number of item in which you are interested → E17

Your Company Name: Brown Mfg Co.
Address: 3718 First Avenue
Pottsville, Okla.
Your Name: John Smith
Your Title: Power Engineer
POWER, 330 West 42nd St., New York 18, N. Y.

FILL OUT AND MAIL TODAY! NOT GOOD AFTER DEC. 1, 1948

Write here number of item in which you are interested →

Your Company Name
Address
Your Name
Your Title
POWER, 330 West 42nd St., New York 18, N. Y. 9/48

Write here number of item in which you are interested →

Your Company Name
Address
Your Name
Your Title
POWER, 330 West 42nd St., New York 18, N. Y. 9/48

Write here number of item in which you are interested →

Your Company Name
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Your Company Name
Address
Your Name
Your Title
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Moisture Remover ..... page 148
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Gas Analyzer ..... page 148
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MANUFACTURERS' BULLETINS

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Boilers and Auxiliaries ..... page 178b
Electrical Equipment ..... page 178b
Maintenance and Safety Equipment. page 180
Maintenance Materials ..... page 180

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead, giving writer's name and title.

AIR CONDITIONING, HEATING REFRIGERATION AND VENTILATING

1 GAS SCRUBBERS AND COOLERS—Peabody Engrg Corp, 580 Fifth Ave, New York 19, N. Y. 4-page bulletin No. H-203 explains the multi-stage and single-stage scrubber and cooler with illustrations and diagramatic sections. This bulletin also has diagrams of the Peabody impingement baffle-plate action and actual performance.

★ **HEAT-TRANSFER PRODUCTS** — Young Radiator Co, Racine Wis. 20-page general catalog No. 148 describes entire Young line of heat-transfer products, including convectors, unit heaters, air-conditioning equipment, radiators, heat exchangers, jacket water coolers, cooling and condensing units, etc.

★ **COOLING COILS** — Modine Mfg Co, Racine, Wis. Section One of cooling coil catalog No. 448 contains descriptive information. Section Two provides physical and technical performance data on water cooling coils. Section Three, to be available shortly, includes technical data on direct expansion coils.

★ **COOLING UNITS** — Young Radiator Co, Racine, Wis. 8-page catalog No. 448 discusses VAD cooling units, which are available in sizes capable of dissipating 3,000,000 to 15,000,000 Btu per hr under standard conditions.

BOILERS AND AUXILIARIES

2 DUAL-FUEL BURNING SYSTEMS—North American Mfg Co, Cleveland 4, Ohio. 4-page bulletin No. DF gives advantages of North American dual-fuel burning systems.

3 FURNACE OBSERVATION DOOR—Bigelow-Liptak Corp, 2842 W Grand Blvd, Detroit 2, Mich. 4-page bulletin No. 30 describes features of Bigelow-Liptak Type A furnace observation door. Installation diagram is included.

4 TURBO BLOWERS—North American Mfg Co, Cleveland 4, Ohio. 6-page bulletin No. 300-S and 4-page bulletin No. 300 discuss Series 300 turbine blowers for industrial combustion systems.

5 FURNACE WALLS — Bigelow-Liptak Corp, 2842 W Grand Blvd, Detroit 2, Mich. 4-page booklet discusses Bigelow-Liptak Budget Walls. Photos and diagrams are included.

6 SPREADER STOKER—Detroit Stoker Co, General Motors Bldg, Detroit, Mich. 48-page catalog gives a complete description of the Detroit RotoGrate stoker and its method of operation. This catalog contains many typical installations. 4-page 50th-anniversary bulletin discusses history of the company.

7 COAL MINING—West Kentucky Coal Co, Madisonville, Ky. 20-page booklet, entitled "Coal Mined by Machines," explains that the modern, mechanized underground mine is clean, well lighted and well ventilated. This booklet documents the progress made by the company during its 75 years of coal-mining operations.

8 CRUDE PETROLEUM AND NATURAL GAS—Standard Oil Co (N. J.) Room 1626, 30 Rockefeller Plaza, New York 20, N. Y. 14-page booklet, entitled "Investments for the Future," tells how this company provides for its growth and development.

9 FUEL-OIL TREATMENT — Alladdin Laboratories, Inc, 68 William St, New York 5, N. Y. 4-page bulletin on Alladdin fuel-oil treatment explains what it is, what it does and how it is used.

10 STEAM GENERATORS — Superior Combustion Industries, Inc, Times Bldg, Times Square, New York 18, N. Y. 4-page booklet describes Superior 2-pass steam generator for oil or gas firing.

11 BOILERS AND STOKERS — James Leffel & Co, Springfield, Ohio. 28-page bulletin No. 236 gives construction features of Leffel Scotch marine boilers and underfeed stokers.

12 SOOT REMOVER—Alladdin Laboratories, Inc, 68 William St, New York 5, N. Y. 4-page folder discusses advantages and directions for application of Alladdin soot remover.

ELECTRICAL EQUIPMENT

13 LARGE INDUCTION MOTORS — Allis-Chalmers Mfg Co, Milwaukee 1, Wis. 24-page bulletin No. 05B6132A describes large induction motors of squirrel cage, wound rotor, bracket bearing and pedestal bearing types.

(*Continued on page* 180)

FIRST CLASS
PERMIT No. 64
(Sec. 510. P.L.&R.)
NEW YORK, N.Y.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

4c. Postage Will Be Paid by—

POWER
330 West 42nd Street
New York 18, N. Y.

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PERMIT No. 64
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BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

4c. Postage Will Be Paid by—

POWER
330 West 42nd Street
New York 18, N. Y.

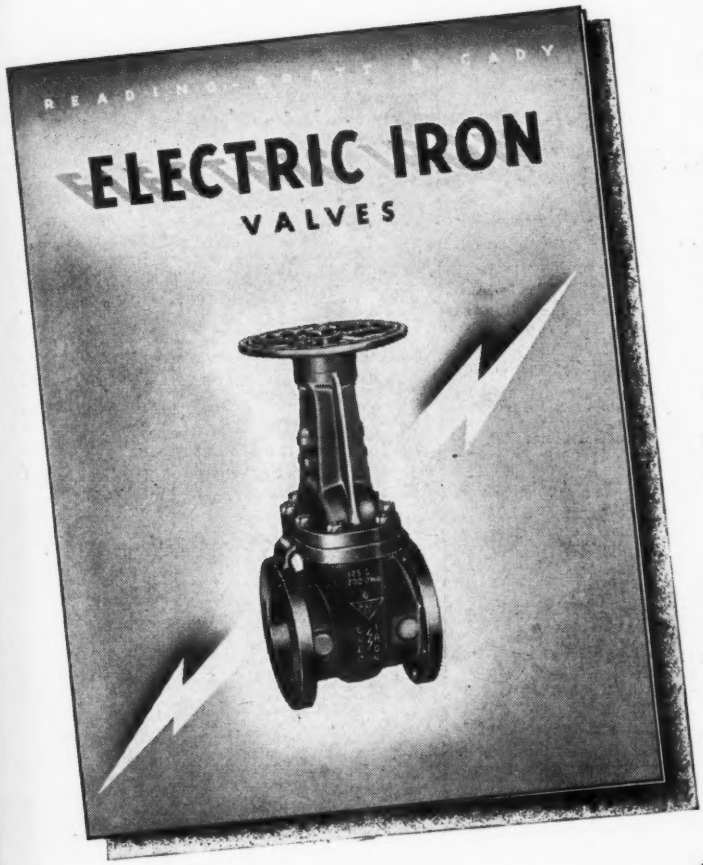
B

Th
fo

A

BETTER IRON MAKES BETTER VALVES AT READING-PRATT & CADY

There is one *BEST* method of melting and refining iron for valve castings. It is R-P&C's *Electric Furnace method.*

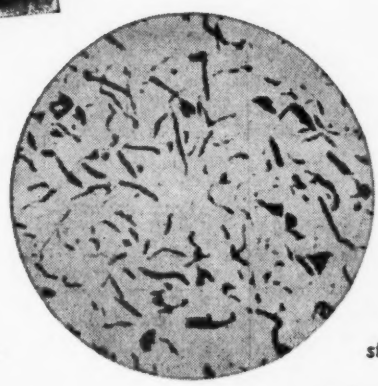


THIS FOLDER tells you why Electric Iron is better than iron made by the conventional cupola process. Interesting information if you buy or specify iron valves. Write for DH-18.

YOU PAY NO PREMIUM for the extra quality in R-P&C Electric Iron Valves. But you do get better valves — longer lasting, more dependable.

Electric Furnace Cast Iron is a low-sulphur, low-phosphorus iron of homogeneous, fine-grained structure. It is clean and of uniform quality.

Before buying or specifying iron valves, get the complete story of R-P&C Electric Furnace Iron. Write for our descriptive folder—DH-18.



UNIFORM STRUCTURE
Photomicrograph (enlarged 100 times) shows even distribution of fine graphite flakes. This contributes to the uniform structure of R-P&C Electric Iron.

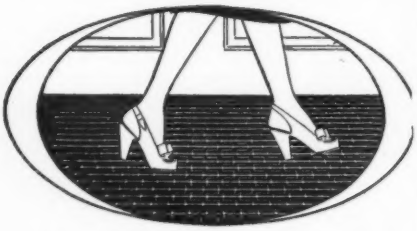
ACCO

Reading, Pa. • Atlanta • Baltimore • Boston • Chicago • Denver • Detroit • Houston
New York • Philadelphia • Pittsburgh • San Francisco • Bridgeport, Conn.

READING-PRATT & CADY DIVISION
AMERICAN CHAIN & CABLE

READING-PRATT & CADY VALVES

THE SAFE OPEN STEEL FLOORING IS TRI-LOK



No object over ½ square inch can pass through super-safe U-Type Tri-Lok Flooring. Fabricated without bolts, rivets or welds, it is unsurpassed for plant installation, walkways, loading platforms. Efficient distribution of concentrated loads . . . maximum free opening for light and air. Write for Bulletin JZ 1140.

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National Distributor for the Tri-Lok Company

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Sales Representatives in Principal Cities

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There are plenty of good pay jobs in the power field today. Increase your earnings now—be a Hays-Trained Combustion Engineer. Just a little of your spare time required for the simple, easy-reading Hays Home Study Course. Hundreds of others have made better jobs for themselves through Hays training. So can YOU.

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14 METALLURGICAL PRODUCTS — Chemical Dept, General Electric Co, Pittsfield, Mass. 8-page bulletin No. CDM-12 discusses GE cast and sintered Alnico, Cunife, Cunico, Vectolite, Silmanal and various permanent magnet holding assemblies.

15 HEAVY-DUTY INDUCTION MOTORS—Electric Machinery Co, Minneapolis 13, Minn. 8-page bulletin No. 1300-PRD-189 and 6-page bulletin No. 1300-PRD-190 give protective features, construction and provisions for low maintenance of E-M heavy-duty squirrel-cage induction motors.

16 INDUCTION MOTORS AND GENERATORS—Arma Corp, 254 36th St, Brooklyn 32, N. Y. 12-page booklet presents a line of induction motors and generators designed specifically for high performance servo and instrumentation applications.

17 ELECTRICAL LINE — Clark Electronic Laboratories, Palm Springs, Calif. 12-page booklet No. 117 describes Celab selenium tubes, acyclic generators, multispeed selenium, motor controls, power rectifier tanks, etc.

MAINTENANCE AND SAFETY EQUIPMENT

18 GAS-ELECTRIC BLOWTORCH — North American Mfg Co, 4455 E 71st St, Cleveland 5, Ohio. Bulletin No. 170 gives installation instructions for North American portable gas-electric blowtorch.

19 TUBE CLEANERS—Roto Div, Elliott Co, Newark, N. J. 4-page bulletin No. J-410 describes entire Rotojet Junior line of Rotojet tube cleaners. This bulletin shows various cutter heads, brushes, lubricators, operating hose and related accessories.

20 TOOL EQUIPMENT—Snap-On Tools Corp, Kenosha, Wis. 104-page catalog S presents Snap-On wrenches, screw drivers, punches, chisels, pliers, saws, files, drills, grinders, reamers, tool sets, tool cabinets, etc.

21 REFRACTORY GUN—Quigley Co, 527 Fifth Ave, New York 17, N. Y. 4-page bulletin No. 310-A discusses Quigley refractory gun for quick furnace repairs.

MAINTENANCE MATERIALS

22 PROTECTIVE COATINGS — Insul-Mastic Corp of America, Oliver Bldg, Pittsburgh Pa. 40-page booklet contains a study of composition, properties and method of application of Insul-Mastic protective coatings.

23 BUILDING MAINTENANCE—Stonhard Co, 401 N Broad St, Philadelphia 8, Pa. New Stonhard maintenance folder covers every maintenance problem from foundation to roof of a building. This folder shows how any handy man can make expert repairs.

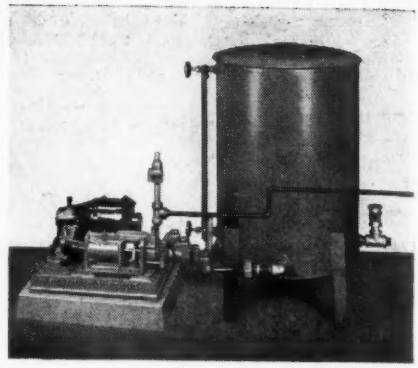
24 ROOFING SHEET — International Nickel Co, 67 Wall St, New York 5, N. Y. 24-page booklet present data on a new, soft-temper monel roofing sheet, designed to overcome severe roofing conditions.

25 ADDITIVES FOR PETROLEUM LUBRICANTS—American Cyanamid Co, 30 Rockefeller Pl, New York 20, N. Y. 20-page booklet, "Chemical Additives for Petroleum Lubricants," explains what additives are, why they are needed, when and where they are used, and how they improve lubricating oils.

26 SILICONE MOLD RELEASE AGENTS—Dow Corning Corp, Midland, Mich. 16-page pamphlet gives general properties of Dow Corning silicone mold release agents, as well as major applications in fields of lubricating tire molds and curing bags, and in lubrication of mechanical rubber goods, floor tile and plastics.

27 VALVE PACKING—Edward Valves, Inc, East Chicago, Ind. 4-page catalog section 12-R describes all types of EValpak die-molded packing. This catalog gives full details and prices of EValpak sets for each size and pressure class of Edward steel valves.

MILTON Roy CHEMICAL PUMPS



Complete Feed Systems for Boiler Water Chemical Treatment

Milton Roy "Packaged" Units for chemically treating boiler water are available to feed sodium sulfite into the suction side of the feed water pump and to feed other chemicals, such as phosphates, soda ash and caustic directly into each boiler. Both methods are usually recommended for the correct treatment of boiler water.

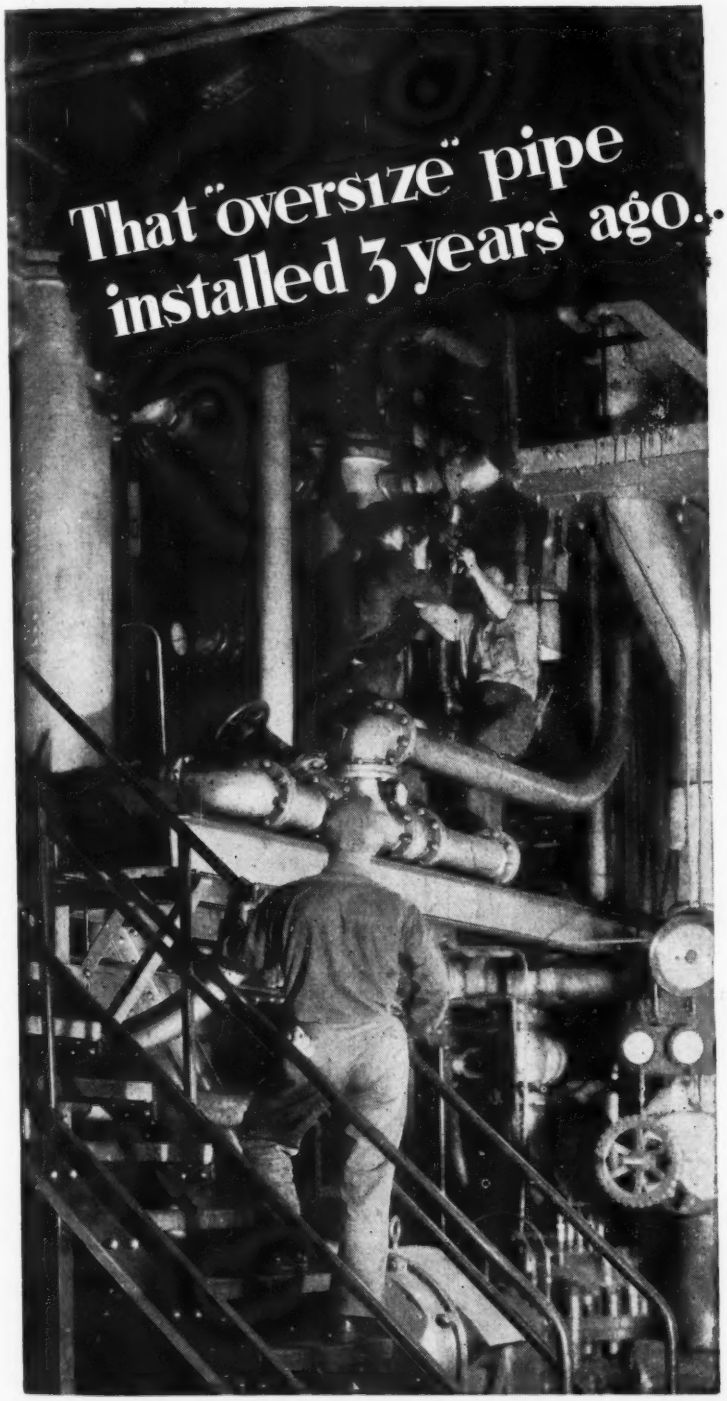
- TO REMOVE DISSOLVED OXYGEN, INSURE AGAINST CORROSION AND PREVENT PITTING.
- TO PREVENT SCALE FORMATIONS, CONTROL ALKALINITY AND PREVENT EMBRITTLEMENT.

Units are complete with Milton Roy Pumps, tanks, gages, low-level pump cutouts and alarms . . . are available in a wide range of capacities to meet all requirements. Complete electronic controls and meters can be supplied to operate pumps automatically at rates directly proportional to feed water flow.

Write for Bulletin 451 also Technical Paper 51 "What the Power Engineer Needs to Know About Chemical Feed Systems for Water Treatment."

MILTON Roy COMPANY
1305 E. MERMAID LANE, CHESTNUT HILL, PHILA. 18, PA.

INSTALL STEEL PIPING ADEQUATE FOR TOMORROW'S NEEDS



That "oversize" pipe installed 3 years ago...takes care of the new extension

THE owner of an eastern food plant is congratulating himself on what he had always thought was an extravagant, though necessary investment. A few years ago, when he installed new processing equipment, the only pipe he could secure quickly was what he thought was "oversize." But he put it in.

Now greater demand for his product is leading him to increase his plant capacity. One thing he isn't worrying about is his piping system. That "oversize" pipe of 3 years ago is adequate to handle the extension. Today he *knows* it was an excellent investment.

Too many owners--and contractors, too--are inclined to rely on minimum pipe sizes--not anticipating that what's barely adequate now may soon be completely inadequate. Remember--it's long run economy to install steel pipe adequate to do a job today AND TOMORROW.

Distributors in all industrial markets handle Youngstown pipe in a wide range of sizes.

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THE YOUNGSTOWN SHEET AND TUBE COMPANY

GENERAL OFFICES - YOUNGSTOWN 1, OHIO

Export Offices - 500 Fifth Avenue, New York City

Manufacturers of

CARBON - ALLOY AND YOLOY STEELS

Pipe and Tubular Products-Sheets-Plates-Electrolytic Tin Plate-Coke Tin Plate.

Conduit-Bars-Rods-Wire-Cold Drawn Carbon Steel Rounds-Tie Plates and Spikes.

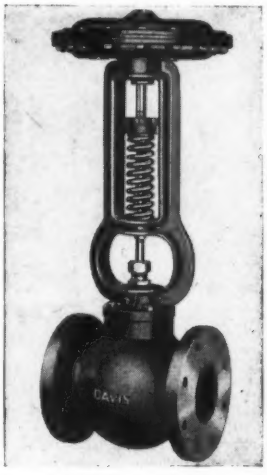
PRESSURE REGULATORS

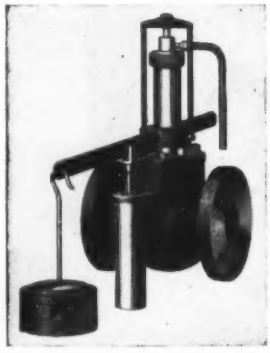
No. 13

(*Left*) Here is everything you need for good pressure regulation on small steam, air, or gas-operated units. compact, self-contained; built-in strainer. Parts accessible without disturbing piping. Tight closing, non-sticking single seat valve. Sizes ⅜" to 2". For pressures to 250 p.s.i.; reduced pressures from 1 to 100 p.s.i.

No. 14

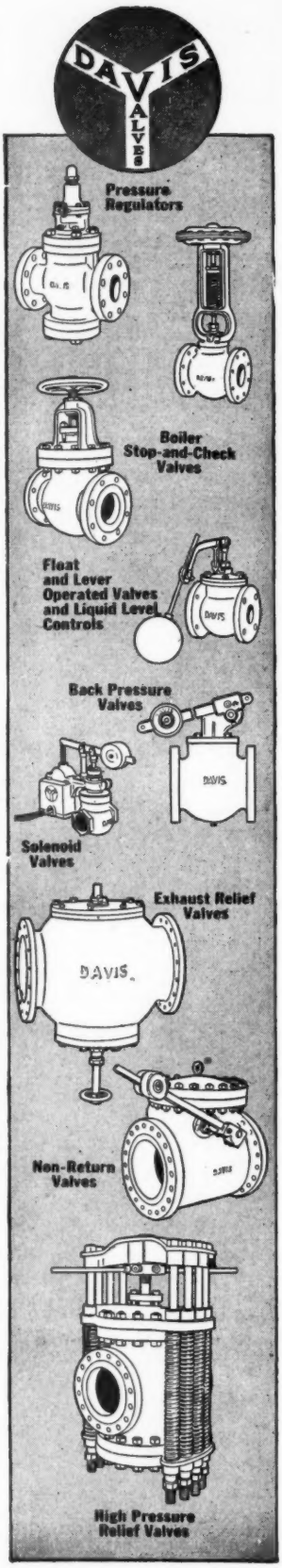
(*Right*) A direct connected, spring loaded pressure reducing valve designed for general industrial service on steam, air, gas, water, or oil. Features parabolic balanced disc construction with full port area. Immune to high pressure fluctuations. Control pressure to diaphragm chamber from reduced pressure line. Sizes ½" to 14". Screwed or flanged connections. Bronze, monel, or stainless steel trim. For pressures to 400 p.s.i.; any reduced pressure up to 200 p.s.i.





No. 2

(*Left*) Preferred by many engineers for smooth, dependable regulation of steam, air, or water pressure. Double seated, balanced, piston disc is unaffected by high pressure fluctuations. Counterweight and external oil dashpot make for close, accurate control on variable loads. For initial pressures to 600 p.s.i. and reduced pressures from 2 to 150 p.s.i. Sizes from ½" to 14".



The Davis Line of Pressure Regulators Is Complete!

• 18 different types to choose from; standard sizes up to 24" and for pressures up to 500 p.s.i. Davis recommendations are not biased by any favored types. As the job dictates, you are free to choose between direct or pilot control . . . spring or weight loading . . . piston or diaphragm action. You have your choice of the degree of the sensitivity needed for the job—you don't have to pay for more than you need. Ask for a copy of Davis Bulletin No. 100A. For recommendations, send complete information on your job.

DAVIS REGULATOR CO.

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MATERIALS HANDLING

28 MODERN ELEVATORS — Otis-Elevator Co, 260 11th Ave, New York 1, N. Y. 12-page booklet No. B-2051 (8440) discusses origin and development of modern elevator supervisory control systems. 16-page bulletin No. B-721 (8450) presents Autotronic elevatoring, an elevator system than handles all traffic patterns automatically.

29 MATERIALS - HANDLING MACHINERY—Robins Conveyors Div, Hewitt-Robins Inc, 270 Passaic Ave, Passaic, N. J. 4-page bulletin No. 125-A serves as a ready reference guide of items utilized in handling of bulk materials in quantity.

30 ELEVATOR EQUIPMENT — Otis Elevator Co, 260 11th Ave, New York 1, N. Y. Bulletin No. B-697 (10-47) describes Type 30-S Otis car gate operator. Operation instructions are included. Bulletin No. B-696 (8430) discusses Otis door holders for use on manually operated sliding hoistway doors that are equipped with automatic door closers. Bulletin No. B-43 (8440) gives operating features of Type N Otis bar interlock. Bulletin No. B-592 (8440) covers Type 0 Otis electric operator for car and hoistway doors.

31 WIRE ROPE — Advertising Dept, R G LeTourneau, Inc, Peoria, Ill. Wall chart, Form No. N-109, lists features incorporated into design and production of Tournarope, gives types and constructions, and presents its applications in earth-moving, hauling and lifting equipment fields. This chart also lists cable requirements for LeTourneau scrapers, cranes, Dozers and Rooters.

32 MODERN ESCALATORS—Otis Elevator Co, 260 11th Ave, New York 1, N. Y. Bulletin No. B-722 (8450) describes and pictures the new Rike-Kumler Escalators in Dayton, Ohio. Bulletin No. B-2057 (8430) discusses fire safety for Escalators.

MECHANICAL TRANSMISSION

33 BEARING LIFE—James F Lincoln Arc Welding Foundation, Cleveland 1, Ohio. 8-page bulletin, entitled "Elastic Matching Improves Bearing Life and Performance," by J G Baker, discusses basic concepts and calculations on proper loading of bearings.

34 RAIL BASE—Korfund Co, 48-23 32nd Pl, Long Island City 1, N. Y. 4-page catalog No. TR-801 describes fan and motor installation with the new Korfund Duplex twin rail base.

35 FLEXIBLE COUPLINGS — Ajax Flexible Coupling Co, Westfield, N. Y. 24-page catalog No. 48 contains working data on complete line of Ajax flexible couplings.

36 MAGNETIC DISK BRAKES — Stearns Magnetic Mfg Co, Milwaukee, 4, Wis. Bulletin No. 605-6X describes the new Series X-60 magnetic disk brakes for fractional hp application, including 1/6, 1/4, 1/3, 1/2 and 3/4 hp.

METALS AND ALLOYS

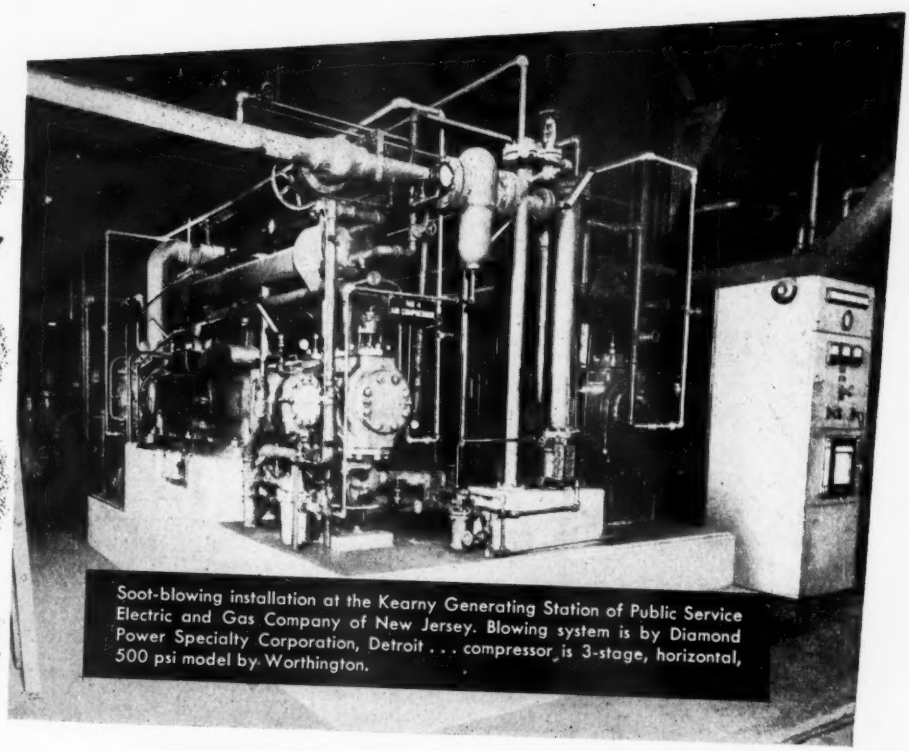
37 TUBE STEELS—Advertising Dept, Babcock & Wilcox Tube Co, 85 Liberty St, New York 6, N. Y. New edition of bulletin on B & W Croloys gives technical data on high-temperature steels for alloy tubes and pipe.

38 SILVER BABBITT METAL — National Bearing Div, American Brake Shoe Co, 4930 Manchester Ave, St. Louis 10, Mo. Booklet details physical properties and outlines pouring procedures of No. 397 silver babbitt metal, an alloy of silver with lead that is said to be equivalent in physical properties to tin-base babbitts.

39 CORROSION RESISTING ALLOYS —Duriron Co, Dayton 1, Ohio. 8-page bulletin No. 114 discusses nickel-molybdenum and nickel-molybdenum-chromium alloys.

40 METALLIC MOLYBDENUM — Climax Molybdenum Co, 500 Fifth Ave, New York 18, N. Y. 391-page book, entitled "Molybdenum: Steels, Irons, Alloys," gives varied applications of molybdenum as an alloying element. This book covers a wide range of materials, from wrought to cast steels and from cast iron to nonferrous alloys.

FOR TOP EFFICIENCY IN SOOT BLOWING



Soot-blowing installation at the Kearny Generating Station of Public Service Electric and Gas Company of New Jersey. Blowing system is by Diamond Power Specialty Corporation, Detroit . . . compressor is 3-stage, horizontal, 500 psi model by Worthington.

WORTHINGTON COMPRESSORS MAKE A CLEAN SWEEP

Correct boiler cleaning is yours . . . at a saving in labor . . . when you put an automatic, compressed-air soot-blowing system to work. Compressed air as a cleaning medium offers savings in fuel and savings in feed-water make-up. In addition, the possibility of tube erosion is reduced because condensate is not present in the blowing medium.

SOOT BLOWING AT KEARNY GENERATING STATION

At the Kearny Generating Station of the Public Service Electric and Gas Company, N. J., boiler cleaning became increasingly important, due to a rise in the ash content of the coal. Soot blowing with steam resulted in erosion of the tube surfaces. In addition, the replacement of water removed from the system required chemical treatment and pre-heating.

Compressed-air soot blowing overcame these disadvantages. The Kearny installation operates on an automatic cycle. In the "fog bank" section, four telescopic, long retracting units blow air at about 200 psi over the surface of the tubes, rotating 360 degrees during a projecting and retracting cycle. Short retracting blowers arranged in groups clean the boiler walls and sloping floor.

The booklet, "Worthington Compressors for Soot Blowing" proves *there's more worth in Worthington.* Write for your copy. *Worthington Pump and Machinery Corporation, Compressor Division, Buffalo, New York.*

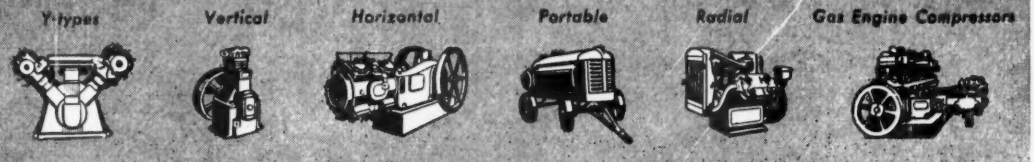
K7.17

ONLY COMPRESSED-AIR SOOT BLOWING GIVES YOU ALL THESE ADVANTAGES

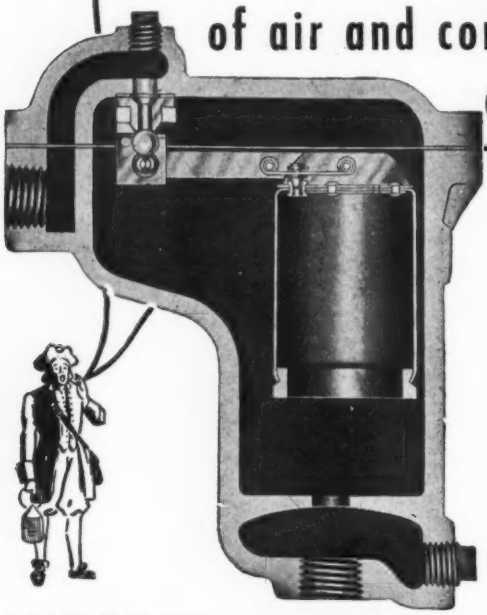
Saves Fuel . . . Saves feed-water make-up . . . Reduces possibility of tube erosion . . . Permits use of lower-cost, low-temperature piping . . . No piping insulation required . . . Reduces soot blower maintenance . . . Dryer blowing medium . . . More effective medium for slag removal.

WORTHINGTON

NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON



. . . for quick, dependable removal of air and condensate . . . . . call on CRYER



All mechanical details on Cryer Bucket Type Traps have been proved in service over a period of many years. Their quick venting, large capacity, ease of maintenance and long life have established their superior performance.

While Cryer Traps are made in sizes up to 2½", a popular model is the No. 20 Junior, ½" Trap, especially recommended for such applications as unit heaters, laundries, dairies, etc.

Cryer also makes Thermostatic Radiator Traps as well as all sizes of traps and repair parts for the line formerly known as the J-M Ball Steam Trap.

DELIVERY FROM STOCK . . . and available from leading distributors everywhere. Send for full details.

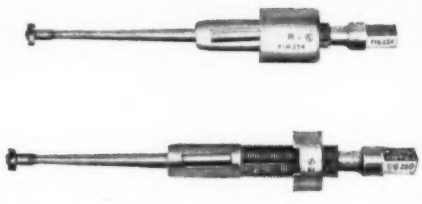
CRYER TRAP AND VALVE CO., INC.

366 MADISON AVE. NEW YORK 17, N. Y.

Manufacturers of steam specialties for over forty years

Wiedeke

TUBE EXPANDERS FOR DEPENDABLE . . . ECONOMICAL SERVICE



WIEDEKE Adjustable Tube Expanders
Designed especially for rolling small tubes in Condensers, Heat Exchangers and similar units.
Style No. 254 is adaptable for rolling tubes to a depth of 2"
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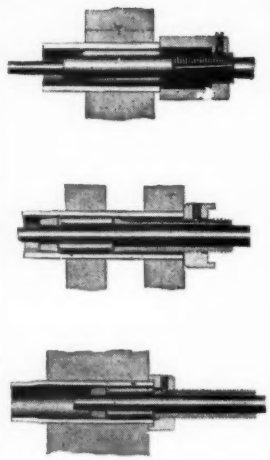
Leading users everywhere know there is a Wiedeke Tube Expander for every application.
For complete details, see your local dealer or write us today



The Gustav Wiedeke Company
DAYTON 1, OHIO

METERS AND INSTRUMENTS, ELECTRIC

41 ELECTRONIC PYROMETER CONTROLLER — Bristol Co, Waterbury 91, Conn. Bulletin No. PB1237 describes application of new electronic pyrometer controller in proportioning current input to electrically heated furnaces, ovens, plastic molding machines, salt pots and other similar equipment to provide practically straight line control.

42 LOW - RESISTANCE MEASUREMENTS—James G Biddle Co, 1316 Arch St, Philadelphia 7, Pa. 12-page bulletin No. 24-25-24 on the Ducter low resistance ohmmeter is a handbook on low-resistance measurements in the shop and in the field.

43 GRAPHIC METERS — Esterline-Angus Co, Box 596, Indianapolis 6, Ind. Booklet, entitled "Solving Industrial Crimes, Case No. 1," tells how an engineer in a steel mill saved the firm money by putting a graphic meter in the main electrical circuit so that it would make a record of the entire power load.

PIPING, FITTINGS, VALVES AND SPECIALTIES

44 ADJUSTABLE PORT VALVES — North American Mfg. Co, Cleveland 5, Ohio. Bulletin No. 1 describes construction and operation of North American adjustable port valves. Applications are given.

45 TUBE FITTINGS — Imperial Brass Mfg. Co, 1200 W Harrison St, Chicago 7, Ill. Bulletin No. 352, entitled "Handy Data on Brass Fittings," discusses various types of fittings and gives handy size and price listings. It also shows a broad range of 2- and 3-way shutoff valves and drain cocks.

46 BRONZE GATE VALVES—Lunkenheimer Co, Cincinnati 14, Ohio. Folder No. 574 presents new line of Lunkenheimer bronze gate valves. Construction and operating features are included.

47 CONDENSATE DRAINING — Sarco Co, 350 Fifth Ave, New York 1, N. Y. 8-page technical bulletin No. 2, entitled "Getting the Best Out of Your Steam Heated Drying Cylinders," describes the new Sarco system of draining and air venting rotating cylinders.

PRIME MOVERS AND ACCESSORIES

48 DIESEL ENGINES — Caterpillar Tractor Co, Peoria 8, Ill. 16-page publication, Form No. 11463, depicts line of Caterpillar diesel industrial engines, marine engines and electric sets operating in their varied capacities on jobs throughout the world.

49 STEAM ENGINE — Ashworth & Parker Ltd, Riverside Works, Bury, Lancs, England. 44-page booklet discusses design, construction and operation of the Parker engine. Applications are included.

50 SURFACE CONDENSERS—Condenser Dept, Elliott Co, Jeannette, Pa. 16-page bulletin No. C-9 describes Type F surface condensers, built in sizes from 500 to 15,000 sq ft. This bulletin includes data on condensate pumps, steam jet ejectors, duplex drainers, air leakage meters, etc.

PUMPS

51 CENTRIFUGAL PUMPS—Worthington Pump and Machinery Corp, Harrison, N. J. 12-page bulletin No. W-305-B1 covers Types CN and CNE centrifugal pumps for pumping hot or cold water, brine, process liquors, light oils and similar liquids.

52 HIGH-PRESSURE PUMPS—Aldrich Pump Co, Allentown, Pa. Aldrich data sheet No. 62 pictures and describes various types and sizes of high-pressure pumps designed and built for pipeline, oil field and refinery service.

53 CENTRIFUGAL PUMPS — Warren Steam Pump Co, Warren, Mass. 6-page bulletin No. 245 presents Types L, LS and A liquor pumps for pumping of hot or cold erosive or corrosive liquids.

Every Plant OPERATING Man needs these

2 important Books!

Lasting Protection for Metal Surfaces
Tells How To PROTECT METAL Surfaces
Dum Dum FOR M
Tells How To PROTECT MASONRY Surfaces
PROVEN SINCE 1912 BUT STILL . . .
. . . The Newest Thing in Stucco and Concrete Restoration
MASONOC
DUM DUM

Long ago, maintenance experts learned that Dum Dum Masonoc, by filling cracks and stopping moisture seepage and deterioration, prevented the need for much costly reconstruction. Today, hundreds of masonry structures evidence the efficiency of this old, established maintenance product.

Now, Dum Dum for Metal offers the same long-term protection to metal surfaces... protects them against all the hazards of weather, industrial fumes and gases... effectively stops rust and creep corrosion.

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- ☐ Please send booklet describing advantages of *Dum Dum for Metal.*
- ☐ Please send booklet describing advantages of *Dum Dum Masonoc.*
- ☐ Please have sales representative call.

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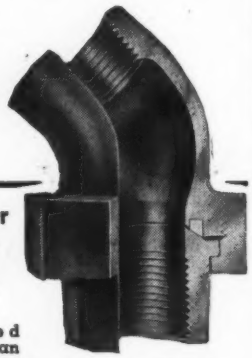
CITY ZONE STATE

JEFFERSON
Specialty Unions

feature the RECESSED BRASS SEAT



. . . for fewer and better pipe joints

The Recessed Brass Seat is an exclusive feature of *all* Jefferson Unions. It is made by inserting a seamless brass ring in a recess away from the runway of the fitting. Location, method of insertion and machining provide leakproof construction. Seating surfaces are ground together in pairs assuring a self-seating ball joint. Jefferson Unions are available in 45° and 90° Union Elbows as well as Union Tees.

Jefferson 45° All-Female Union Elbow. Made also in Male-Female type.

Consult your nearest distributor or get in touch with us direct.

JEFFERSON UNION CO.

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63 Gooding St., Lockport, N. Y.
39 Fletcher Ave., Lexington 73, Mass.

Makes ALL VALVES *INSTANTLY* Accessible

CONTROL FROM THE FLOOR

● Instant, handy, safe control of overhead and other out-of-reach valves. Eliminate danger to employees; banish the stepladder. Now — install valves anywhere they should be, regardless of accessibility.

Inexpensive BABBITT Sprocket Rims fit all types and makes of valves, with either rising or non-rising stems. Installed quickly by clamping directly onto hand wheel of valve. Eliminates makeshift apparatus and specially-made chain wheels.

• Ten standard sizes take care of all valve wheels from 2 to 30 inches in diameter.

• *Request Catalog Bulletin P, prices, name of local distributor:*

Babbitt Adjustable SPROCKET RIM with Chain Guide

BABBITT STEAM SPECIALTY COMPANY
Manufacturers of Adjustable Valve Operating Mechanisms
New Bedford, Mass., U. S. A.

54 SINGLE-STAGE CENTRIFUGAL PUMPS—De Laval Steam Turbine Co, Trenton 2, N. J. 28-page bulletin No. 83-29 on single-stage centrifugal pumps gives outstanding features of De Laval design and construction. This bulletin lists pump ratings and incorporates essential dimensions.

55 CHEMICAL PUMPS — Milton Roy Co, 1300 E Mermaid Lane, Chestnut Hill, Philadelphia 18, Pa. 4-page bulletin No. 484 features a capacity-pressure chart that is really a pump selection chart in simplified form. The chart enables a prospective purchaser to ask for quotations on a standard Simplex or Duplex Milton Roy controlled volume pump.

56 CENTRIFUGAL PUMPS — Ampco Metal, Inc, 1745 S 38th St, Milwaukee 4, Wis. 4-page bulletin No. 85 covers Ampco centrifugal pump made from corrosion-resistant aluminum bronze and designed for a wide range of services where corrosive and erosive liquids must be moved.

WELDING

57 ARC WELDING—Hobart Brothers Co, Hobart Square, Troy, Ohio. 4-page folder describes Hobart ac-ac arc welder and power unit. Photos are included.

58 WELDING INSTRUCTION — Dept A19-24P, Air Reduction Sales Co, 60 E 42nd St, New York 17, N. Y. Folder describes the company's five available welding and cutting instruction books.

59 ARC WELDING ACCESSORIES — Hobart Brothers Co, Hobart Square, Troy, Ohio. 8-page booklet covers Hobart accessories for arc welding. Each item is pictured and described.

60 RESISTANCE WELDING ELECTRODES—Ampco Metal, Inc, 1745 S 38th St, Milwaukee 4, Wis. 28-page revised bulletin No. 68 presents an enlarged and up-to-date listing of resistance welding electrodes and alloys.

OTHER EQUIPMENT

61 MOLDED AND LAMINATED PLASTICS—Chemical Dept, General Electric Co, Pittsfield, Mass. 15-page bulletin No. CDP-578 discusses GE molded and laminated plastics. The bulletin is devoted to a description of design, moldmaking and molding facilities of GE plastics div and covers GE sealing caps and sleeves, mycalex, silicone rubber and GE 1422 high-frequency insulation.

62 COMPANY OPERATION — Dresser Industries, Inc, 1130 Terminal Tower, Cleveland 13, Ohio. 48-page booklet lists the 13 operating companies of Dresser Industries, Inc, and identifies products and services of each.

63 COMPANY HISTORY—Dravo Corp, Neville Island, Pittsburgh 25, Pa. 24-page bulletin No. 902-A traces the history of the corporation back to 1891 when F R Dravo opened a sales agency in Pittsburgh for steam and power plant equipment. More than 50 years of activity in field of power plant and pumping machinery installation for steel mills, public utilities, waterworks and industrial facilities are features in the new booklet.

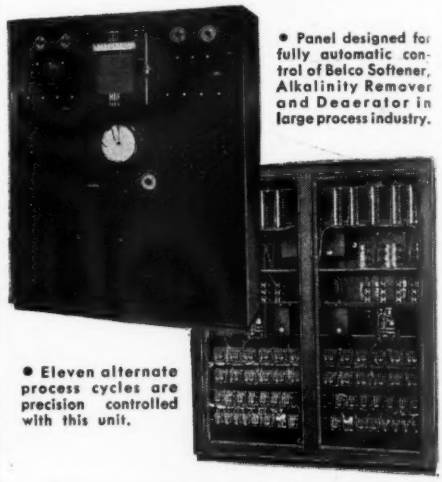
64 ENGINEERING ACHIEVEMENT — Peter F Loftus Corp, Oliver Bldg, Pittsburgh 22, Pa. 46-page booklet, entitled "A Quarter Century of Achievement," discusses a few projects that are representative of Loftus activities and which embrace a wide cross section of engineering practice.

65 AIR COMPRESSOR—Pneumatic Automotive Equipment Assn, Pittsburgh, Pa. 12-page handbook gives best methods of procedure for selecting an air compressor of the right type and size for a specific requirement.

66 BOILER FEED CONTROL—Northern Equipment Co, Erie, Pa. 8-page bulletin No. 481, entitled "Copes Boiler Feed Control at Calco Chemical Division of American Cyanamid Company," contains informative data on this subject. 4-page bulletin No. 483, entitled "Boiler Feed Water Control at the Greenpoint

FOR FULLY AUTOMATIC CONTROL OF ALL WATER TREATMENT PROCESSES

EXPERIENCE COUNTS



• Panel designed for fully automatic control of Belco Softener, Alkalinity Remover and Deaerator in large process industry.

• Eleven alternate process cycles are precision controlled with this unit.

Belco engineers are thoroughly experienced in all phases of completely automatic water treatments. By applying this wide experience to your processes you can avoid the losses that result from outdated control — you can reap the savings that result from modern simplified automatic Belco control. Experience counts . . . Belco has, for example, the advantage gained through designing and building the worlds largest fully automatic demineralization and silica removal plant.

MODERNIZATION OF EXISTING PLANTS RESULTS IN LARGE OPERATING SAVINGS

Ask a Belco engineer how modernization might effect substantial savings in your present operations. Ask about the application of the Belco automatic controls to other processes in your plants.

BELCO INDUSTRIAL EQUIPMENT DIVISION, INC.
50 Iowa Avenue Paterson 3, N. J.
In midwest: Deady Chemical Co., Kansas City, Mo.
In southwest: Watermasters, Inc., Houston, Tex.
In Pacific: Deady Chemical Co., Los Angeles, Cal.

Belco

PROCESSES FOR REMOVAL OF WATER IMPURITIES

Presenting

a pictorial record of standard and special built HEAT TRANSFER EQUIPMENT

by **Vogt**

Write for a copy of Bulletin HE-5, on your letterhead.

You are invited to send for this record of ingenuity in heat exchanger design and construction.

Shown, among examples of the many types we build, are units for diversified applications, high pressures, and special operating conditions as well as conventional types for ordinary exchanger services in petroleum refineries, chemical plants, process industries, power plants, etc.

Thousands of installations in successful operation attest to Vogt's ability to give effective help in the solution of heat transfer problems peculiar to a wide variety of operating conditions.

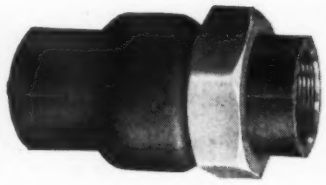
HENRY VOGT MACHINE CO.
INCORPORATED
LOUISVILLE 10, KENTUCKY
BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS

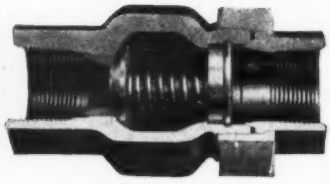
Stop

HAMMERING AND VIBRATION IN YOUR BOILER FEED LINES!

Here's how specify CATAWISSA SINGLE UNION SPRING CONTROLLED CHECK VALVES!

full view





cutaway view

- Positive Seating!
- Eliminate hammering and vibration!
- Easy access to all parts!
- Eliminate additional union and nipple!

For boiler feed lines and other applications requiring maximum dependability!

— RECOMMENDED FOR —

400-lbs. Working Steam Pressure
800-lbs. Pressure AOWG to 150° F.

Tested to 2000-lbs.
Non-Shock Hydrostatic Pressure

See your industrial supply distributor or WRITE DIRECT FOR BULLETIN 10-A

CATAWISSA VALVE & FITTINGS CO.
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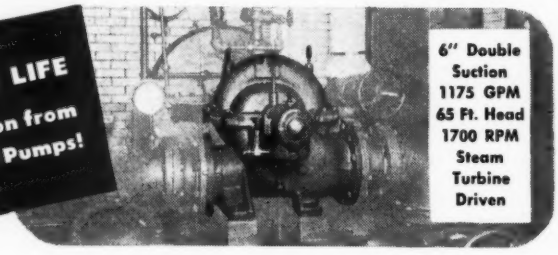
GET EXTRA LONG LIFE
...Economical operation from Frederick Centrifugal Pumps!



Twenty-nine years ago, Frederick Iron & Steel manufactured its first centrifugal pump . . . a 6" Double Suction Volute type. Delivered in July, 1919, this pump is still in operation today at the Dominion Coal Co. in Sydney, Nova Scotia. Minor repair parts over the 29-year period have been furnished promptly by Frederick.

Today, Frederick Iron & Steel is manufacturing a complete line of single and double suction, single and multi-stage centrifugal pumps with the same long-lasting quality built into its first unit. When you buy Frederick pumps you're assured of continuous, economical operation from extra long life.

We have among our designs just the centrifugal pump you're looking for. Drop a line to the address below and we'll gladly send you an attractive, illustrated "file-size" brochure on our pumps as well as the name of our factory representative nearest you. Ask for Bulletin 104.

Frederick
ESTABLISHED 1890
IRON AND STEEL, INC.
Dept. P-4 Frederick, Md.

ALSO MANUFACTURERS OF PRECUT AND PREFORM METALWORKING MACHINERY, FREDERICK STOKERS AND ASH CONVEYORS AND A COMPLETE LINE OF GRAY IRON CASTINGS.

Works of the Brooklyn Union Gas Company," describes the equipment installed for proper boiler feedwater control at this plant.

67 ATMOSPHERIC REGULATORS — North American Mfg Co, Cleveland 5, Ohio. Bulletin No. 18 discusses North American Series 18 atmospheric regulators. Photos, tables and diagrams are included.

68 HEAT EXCHANGERS—Schutte and Koerting Co, 12th and Thompson St, Philadelphia 22, Pa. 12-page bulletin No. 12-H presents comprehensive data on SK single and 2-pass heat exchangers, vapor condensers, U-tube and tank type exchangers, Radiafin tube exchangers and vent condensers.

69 LIQUID LEVEL RECORDER — Yarnall-Waring Co, Chestnut Hill, Philadelphia 18, Pa. 8-page bulletin No. WG-1830 gives construction and installation details of the Yarway Hi-Lo-Graph recorder.

70 LIQUID LEVEL INDICATOR — Yarnall-Waring Co, Chestnut Hill, Philadelphia 18, Pa. 16-page bulletin No. WG-1822 describes operation, construction and installations of Yarway remote liquid level indicators.

71 INDUSTRIAL WATER SOFTENERS—Illinois Water Treatment Co, 891 Cedar St, Rockford, Ill. 4-page folder covers types of Illco-Way water softener units and range of controls available.

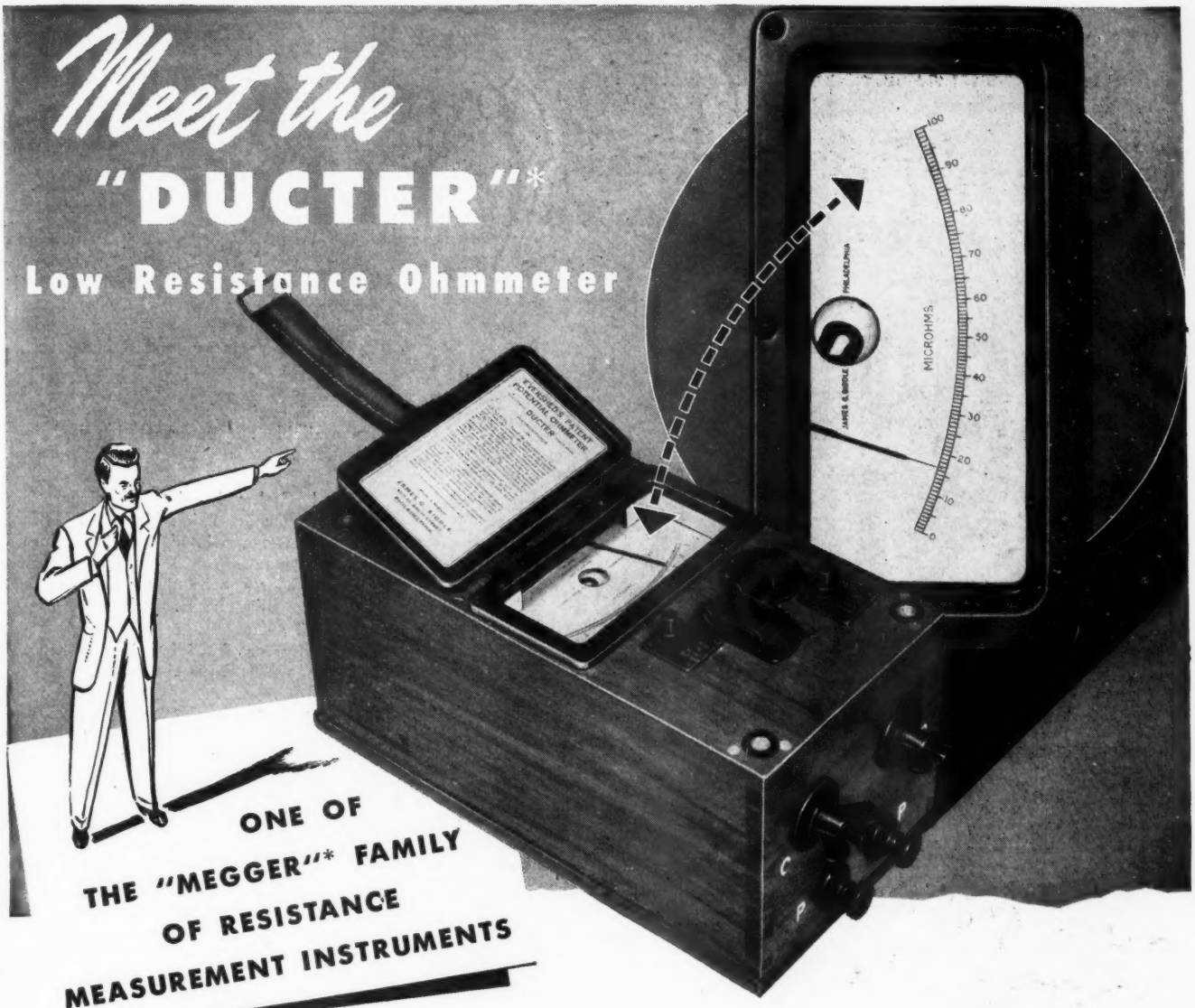
Gulf Oil Corp and Koppers Co announce signing an agreement under which the two companies will engage in cooperative research and development of processes for conversion of coal to gas and liquid fuels. General Brehon Somervell and Sidney A Swensrud, presidents of Koppers and Gulf respectively, made the announcement in a joint statement: "Gulf has long been a specialist in liquid fuels technology; Koppers has long been a specialist in solid fuels technology. We believe it only reasonable to anticipate that our knowledge in these two fields can be combined to develop more promising industrial processes for converting solid fuels into gases and synthetic liquid fuels."

Empire District Electric Co has awarded the general contract for construction of a substantial addition to its Riverton, Kansas power-generating plant to Long Construction Co of Kansas City, Mo. The addition, an extension of the frequency-changer building, will provide space for a 30,000-kw turbine-generator with switchgear and switchboard ordered from Westinghouse Electric Corp, and for a 32,500-sq-ft condenser and a 300,000-lb-per-hr boiler to be provided by Foster Wheeler Corp. The addition will cost upwards of $4,000,000.

Los Angeles water and power commissioners have voted a $40,000,000 bond issue to build three hydroelectric plants in Owens River gorge, each with a single unit of 51,200-hp capacity. Raising Long Valley dam 20 ft will increase storage capacity from 183,000 to 315,000 acre-ft.

The city's dept of water and power also took steps recently toward construction of six hydroelectric power plants on Kings River in the high Sierras east of Fresno. The six plants, estimated to cost about $100 million, would have a total capacity of 250,000 kw. Present plans call for construction to begin in 1951, the year the Owens Valley project is scheduled to be finished.

Meet the
"DUCTER"*
Low Resistance Ohmmeter



ONE OF
THE "MEGGER"* FAMILY
OF RESISTANCE
MEASUREMENT INSTRUMENTS

Rugged, accurate and direct-reading, the "Ducter" Low Resistance Ohmmeter provides an easy and practical way to test air and oil circuit breaker connections and contacts; cable joints; bus bar and line connections; armatures and series fields of generators, and motors; and low resistance transformer windings. It is also a valuable tool in quality control and for indicating relative strength and conductivity of welded joints.

One man can quickly make resistance measurements down to a millionth of an ohm—in the field! There are no calibrations or adjustments—not even for the voltage of the battery that supplies the necessary test current—and there are no calculations or charts. The resistance measurement is read directly from the position of the pointer on a scale.

The "Ducter" operates from an external battery or plug-in power supply. On every range it is compensated for outside temperature changes. As a protective feature a cut-out is included in the circuit to prevent application of too high voltage, and very high resistances or open circuits.

Various ranges of "Ducter" Ohmmeters are available to suit your requirements. A complete description, together with circuit diagrams, applications, and specifications are contained in Bulletin 24-25-P. Write for your copy TODAY and learn all about this truly remarkable instrument.

*REG. U. S. PAT. OFF.

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SEE HOW YOU CAN CUT POWER COSTS AT THE...

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NATIONAL EXPOSITION OF POWER & MECHANICAL ENGINEERING

GRAND CENTRAL PALACE, N.Y.

NOV. 29 to DEC. 4

Over 300 outstanding technically-staffed exhibits and first-hand demonstrations of latest cost-saving equipment, materials and methods for steam, electric and mechanical power production and application—for economical materials handling — for efficient plant services — for expanding and modernizing power facilities. New cost-cutting ideas never were so important as now. So mark the date—plan to attend. See, learn and compare!

Management International Exposition Co.

4545

Appointments

(*Continued from page* 178)

formed to represent manufacturers specializing in chemical processing equipment. Territory covered by the corp is New York State east of Rochester and western Conn. Officers are Robert T Sheen, president; John W Welker, vice-president; Paul C Flucke, secretary; John J Smith, treasurer. Personnel includes A W Lubbers and Ted J. Zeller, sales engineers, and Robert Cohen, office manager. Accounts presently represented are Milton Roy Co of Philadelphia. Chemical engineering consultant services are available and representation is being negotiated for a few additional firms.

Richard C Lowrie, detail engineer for power-plant construction for **Idaho Power Co,** has been appointed resident engineer at the company's $12,000,000 hydroelectric project under construction on the Snake River near Bliss, Idaho.

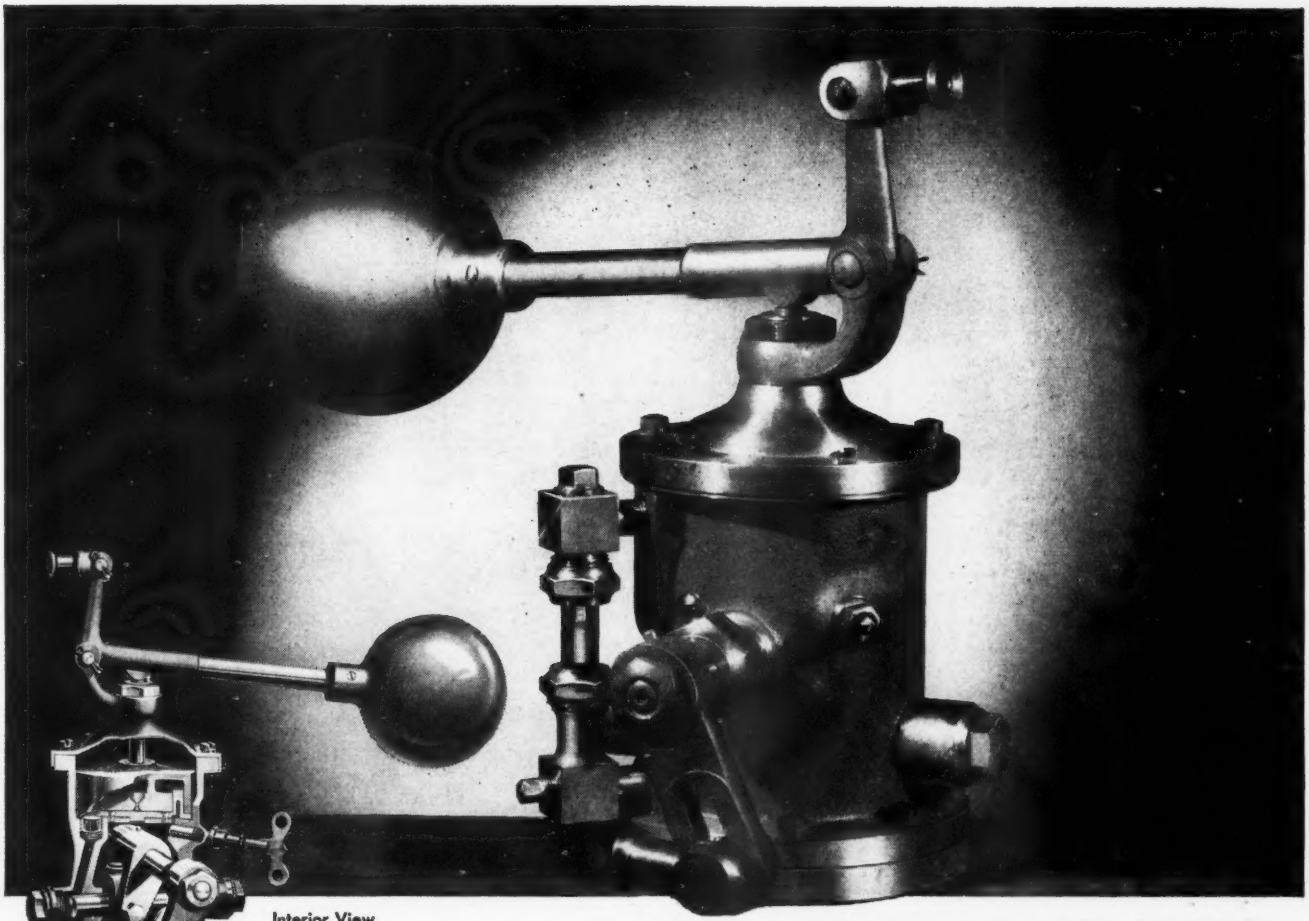
Pacific Power & Light Co has named C H Campbell personnel director.

Coast Counties Gas & Electric Co has elected R L Hayden, director and Contra Costa County (Calif.) regional manager, to vice-presidency of the company.

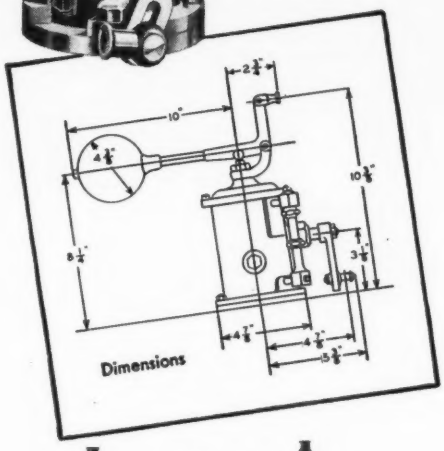
New York University College of Engineering announces addition of three new men and promotion of twelve others on the staff. New men include Dr Herbert Vickers, professor of electrical engineering; Dr John Happel, professor of chemical engineering; and Dr Frank Maslan, assistant professor of chemical engineering. Promotions in electrical engineering dept are as follows: (1) Davis H Beck to assistant professor (2) Philip Greenstein to professor (3) B James Ley to assistant professor (4) Charles Rehberg to associate professor. Mechanical engineering dept promotions are as follows: (1) Dr Nicholas C Kulik to associate professor (2) Emanuel A Salma to associate professor. Mathematics dept promotions: (1) Dr Arthur S Peters, associate professor (2) Irving F Ritter, associate professor. Civil engineering dept: Dr Thomas C Kavanagh, assistant professor. Aeronautical engineering dept: Dr Chi Teh Wang, associate professor. Meteorology dept: Dr Hans Panofsky, associate professor. Engineering drawing dept: Lewis O Johnson, associate professor.

A L Kiewit, for more than 20 years associated with Cincinnati Gas and Electric Co, has been named assistant director of engineering for **Coal Producers Committee for Smoke Abatement.**

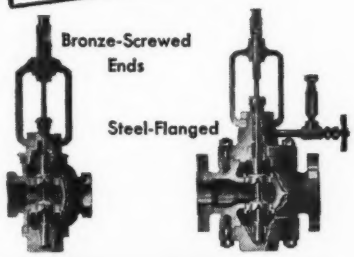
American Institute of Electrical Engineers has elected Everett S Lee, engineer, engineering and consulting laboratory, General Electric Co, Schenectady, N. Y., as president for the year beginning Aug 1, 1948. The other officers elected were: (1) Vice-Presidents Victor Siegfried, Worcester, Mass.; John L Callahan, New York,



Interior View



Dimensions



MASONEILAN CONTROL VALVES

These valves (No. 154-2) are specially designed for use with Masoneilan Steam Pump Speed Governors. Their flow characteristics are ideal for this application. Sizes are ½" through 2", with V-Port valve plugs. Rating: Bronze Body, Screwed Ends – MSS 250 lb. at 475°F. Steel Body, Flanged and Screwed Ends – ASA 300 lb. at 750°F.

MASONEILAN

STEAM PUMP SPEED GOVERNORS

Automatically

Maintain Uniform Speed . . . Prevent Pump Damage Through Over-speed

- **Speed may be adjusted while pump is in motion**
- **Motion arm may be arranged either vertically or horizontally**
- **Governor may be refilled while pump is in motion**

Masoneilan Pump Speed Governors automatically maintain uniform speed of simplex or duplex, double- or single-acting reciprocating steam pumps, and all classes of flywheel pumps, including vacuum pumps, air compressors and ice machines. These pump speed governors are used to prevent over-speed and possible pump damage. It will pay you to investigate Masoneilan Automatic Pump Speed Governors for your reciprocating steam pumps.

MASON-NEILAN REGULATOR COMPANY

1186 ADAMS STREET, BOSTON 24, MASS., U. S. A.

Sales Offices or Distributors in the Following Cities:

New York • Buffalo • Chicago • St. Louis
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"GUNITE" Concrete

(since 1915)

Linings for

STEEL BUNKERS •
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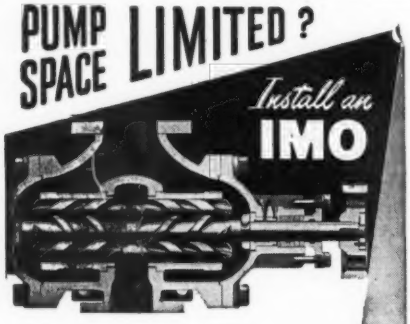
PUMP SPACE LIMITED?

Install an IMO



• The capacity of the IMO is increased by high speed operation. This compact pump can be directly connected to the driving machine without bulky speed reduction gearing.

• IMO Pumps can be furnished for practically any capacity and pressure required for oil, hydraulic-control fluids and other liquids.

Send for Bulletin I-146P

IMO PUMP DIVISION of the
DE LAVAL STEAM TURBINE CO.
TRENTON 7, NEW JERSEY

N. Y.; Ira A Terry, Fort Wayne, Ind.; George N Pingree, Dallas, Texas; Richard McKay, Spokane, Wash. (2) Directors Clarence W Fick, Cleveland, Ohio; Morris D Hooven, Newark, N. J.; F O McMillan, Corvallis, Ore. (3) Treasurer W I Slichter, New York, N. Y. (reelection).

A newly organized section of **American Institute of Electrical Engineers** at Richland, Wash., where General Electric Co operates Hanford Works for Atomic Energy Commission, announces the following officers: (1) H R Hughes, of the project engineering div of GE, chairman (2) W P Dowis of the design div, vice-chairman (3) J H Hemperly of the project engineering div, secretary treasurer (4) M H Arndt and R B Crow of Atomic Energy Commission and F Ellis Johnson and F J Mollerus of GE, executive committee.

American Society for Metals has appointed Walter Morrison director of public relations. Morrison replaces Graves Taylor, who has resigned and will move to Tryon, N. C.

Dr Gustav Egloff, director of research, Universal Oil Products Co, has been re-elected president of **Chicago Technical Societies Council.** Other officers for the 1948-1949 term are: (1) Dr Clyde A Crowley, executive vice-president (2) Lewis A Bain, Robert H Bacon, Dr Herman S Bloch and Paul S Smith, vice-presidents (3) R T Van Niman, corresponding secretary (4) William Kucinski, recording secretary (5) Frederic E Oakhill, treasurer.

Earl C Payne, Pittsburgh, consulting engineer for Pittsburgh-Consolidation Coal Co, has been named acting director of **Fairmont Coal Bureau,** succeeding Julian E Tobey who has resigned to rejoin Appalachian Coals, Inc, as its president.

Evan F Wilson has become the assistant director of div of raw materials for **U. S. Atomic Energy Commission.** The div has its headquarters at 70 Columbus Ave, New York, N. Y.

Burton C Mallory has been named chief mechanical engineer of **Stone & Webster Engrg Corp,** Boston. He succeeds the late James A Powell. Alden D White has been made assistant chief mechanical engineer.

Gilbert Associates, Inc, engineers and consultants, announces opening of its Houston office with Aaron P Campbell, vice-president, in charge.

Iron & Steel Products, Inc, Hegewisch Station, Chicago 33, Ill., has elected following officers: (1) John F Parker, president and treasurer (2) W J Parker, executive vice-president and secretary (3) Charles A Marshall, vice-president and general manager (4) J J Collins, assistant general manager.

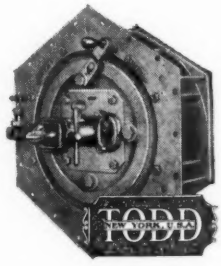
H K Ferguson Co announces formation of a new atomic energy div to specialize exclusively in nuclear engineering problems. Dr Karl Cohen will direct activities

THERE'S STILL TIME TO MODERNIZE YOUR BOILER PLANT

WITH TODD BURNERS

You *can* replace obsolete equipment with Todd Burners and be ready for winter. The capacity of the Todd organization . . . world-wide distributors and facilities . . . standardized equipment . . . are your assurance of economy and efficiency in the burning of liquid and gaseous fuels. Take advantage of the long experience and "know how" of Todd engineers.

Oil Burners
Gas Burners
Combination Oil and Gas Burners



COMBUSTION EQUIPMENT DIVISION
TODD SHIPYARDS CORPORATION
81-16 45th Ave., Elmhurst, Queens, N. Y.

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HARRISBURG • YORK • CHICAGO • CHARLESTON, S. C. • BOSTON • SPRINGFIELD, MASS.
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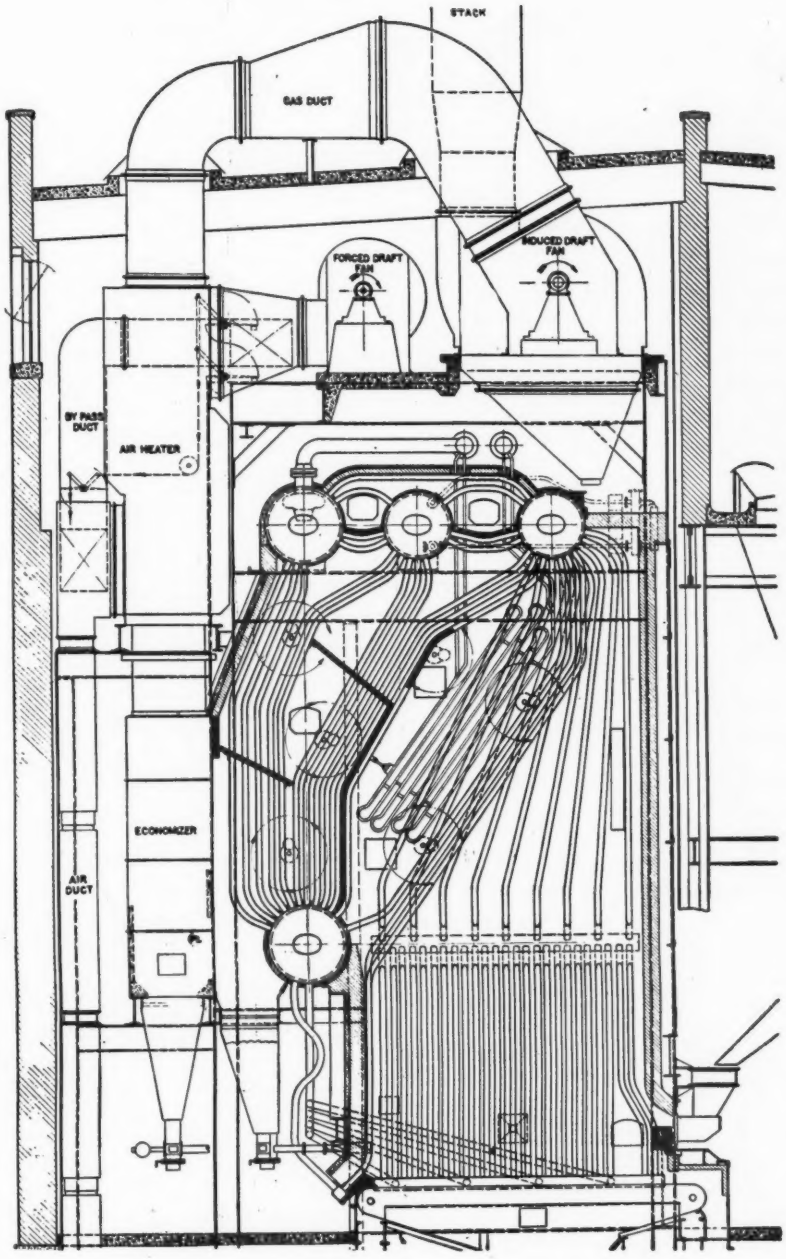
SEATTLE • MONTREAL • TORONTO
BARRANQUILLA • BUENOS AIRES • LONDON

THE J. I. CASE TRACTOR WORKS
SELECTS A
DUPLICATE GENERATOR



Cross-section of one unit installed at J. I. Case

To generate steam at the modernized tractor works of the J. I. Case Company, Racine, Wisconsin, a 75,000#/hr Murray Steam Generator was purchased in 1942. To provide for further expansion, a duplicate of this unit was recently purchased. What better testimonial could there be regarding the performance and efficiency of this unit.

Operating at 450 pounds pressure 750° F. total temperature, these units will carry peak loads over 100,000 pounds per hour each. Fueled with 25% coal and 75% coke breeze these boilers show an average operating efficiency of over 85%, saving over $100.00 per unit per day in fuel.

SIMILAR INSTALLATIONS NOW BEING MADE AT:

City of Ames, Iowa
City of Webster City, Iowa
City of Hannibal, Missouri
City of Sibley, Iowa
City of Chillicothe, Missouri
City of Mt. Pleasant, Iowa
City of Cedar Falls, Iowa
City of Alliance, Nebr.

Be sure to ask for data on MURRAY boilers. A wide range of sizes is available for your modernization or expansion plans.

• • •

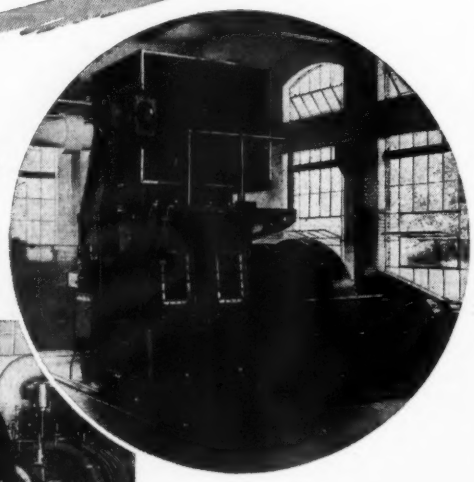
MURRAY ALSO Produces:

Steam Turbine Generators to 2,500 KW rating
High Speed Reduction Gears
Multistage Type "UV" Turbines
Single Stage Mechanical Drive Type "U" Turbines
Vertical Turbines

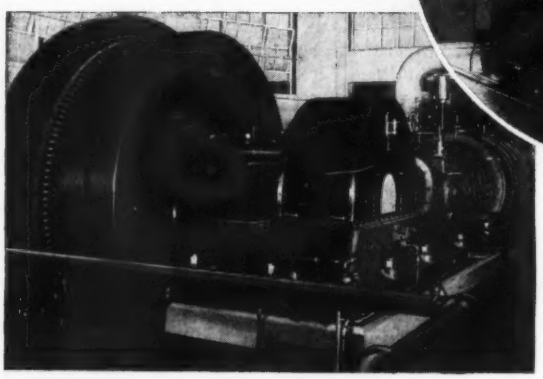
MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA
BUILDERS OF STEAM POWER EQUIPMENT FOR THREE-QUARTERS OF A CENTURY

Skinner "UNIVERSAL UNAFLOW"

Steam Engines



VERTICAL TYPE



HORIZONTAL TYPE

• WHAT THEY ARE

The Skinner "Universal Unaflow" Steam Engine is the outstanding reciprocating prime mover of this era, made by the largest exclusive manufacturer of steam engines in America. The performance of thousands of "Universal Unaflow" engines, in almost every type of industry and institution, daily demonstrates the truth of our claim—that they are "the most economical steam engines built."

"Universal Unaflow" engines are correctly designed for simplicity, dependability, heavy duty service, flexibility, and permanently maintained economy. They are available in sizes ranging from 75 to 2,250 horsepower, and in horizontal or multi-cylinder vertical types.

• WHAT THEY DO

Skinner "Universal Unaflow" Steam Engines are built for direct connection, coupling, or belt drive, to electric generators, compressors, blowers, pumps, lineshafts, or other load.

Over 2000 power users, in industries and institutions, have found it more economical to generate their own power with "Universal Unaflow" engines than to purchase power from the local utility, or to generate power with other prime movers.

Exhaust steam is available to be utilized for heating, for laundry, for processing techniques, and many other purposes, further adding to the savings enjoyed through use of "Universal Unaflow" engines.

Skinner "Universal Unaflow" engines are frequently bought under our Guaranteed Saving Contract, payments being made out of proved savings after the engine is in service. Write for detailed information of the advantages of Skinner "Universal Unaflow" engines in your industry.

For Over 80 Years, Doing One Thing Well — Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.

of this div. Dr William I Thompson will head engineering section of the technical group. Other personnel to form a nucleus of this group have been drawn from the engineering dept of Ferguson Co, including J T Weills, until recently a group leader in technical div of Clinton Laboratories, Oak Ridge, Tenn.

Harry C Williams has been appointed general sales manager of **H K Ferguson Co.**

OBITUARIES

Maurice M Sellers, who retired July 1, 1941, after 38 years of service at Springfield plant of Elliott Co, died in St. Petersburg, Fla. on July 6.

George W Dolan, 46, chairman of board of directors of Mathieson Chemical Corp (formerly Mathieson Alkali Works) died in New York City on July 24 after a brief illness.

Albert G Bladholm, 43, president of Iron & Steel Products, Inc, of Chicago, died on July 6.

John E Lawson, 67, president and director of Canadian Niagara Power Co Ltd, died at his home in Niagara Falls, Ont. on July 23.

Michael J Lenahan, 72, a retired stationary engineer, died at his home in Buffalo, N. Y. on July 24.

William F Robbins, plant engineer of Graton & Knight Co, Worcester, Mass. died in that city on June 13.

Wesley Milton Colter, 65, retired stationary engineer for Pennsylvania Electric Co, Erie, Pa. died June 17 in his home in Erie. He had been associated with the utility firm for 27 years before retiring in 1945.

Samuel P MacFadden, 53, executive vice-president of Puget Sound Power & Light Co from 1942 to 1946 and consultant for that company since 1946, died May 22 at Seattle, Wash.

Wilbert C Snow, 61, assistant superintendent of Seattle, Wash. City Light for the past five years, died May 20.

William A Schmid, 59, stationary engineer with Great Atlantic & Pacific Tea Co in Buffalo for many years, died May 31.

Frank A Woodworth, 71, a stationary engineer for Agate Ice Cream Co, Rochester, N. Y. for 18 years, died on June 29.

James A Conley, 59, a stationary engineer for Buffalo Board of Education for many years, died July 5.

William J Dunnan, 66, formerly chief engineer of John Daldy Co, Watertown, Mass. died on July 15 at Stoneham, Mass.

Harry Diamond, 48, chief of electronics div of National Bureau of Standards, died suddenly at his Washington, D. C. home on June 21.

David W Bright, 48, superintendent of Union Electric Company's generating plant at Venice, Ill. died on June 16. He was a former president and treasurer of National Assn of Power Engineers.

Jay Russell Geib, 59, veteran power engineer of New York State Electric & Gas Corp, died at his home in Binghamton July 19 after a long illness.

Here's water that's

This new Permutit chemical process produces the equivalent of evaporated make-up water at tremendous savings. Permutit has added to its ionic demineralizing plant this one-step cold process silica removal unit. The result: *low silica* (less than 0.5 ppm) *demineralized water!*

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For full details on this Permutit process, and on other Permutit products for power plants, write to The Permutit Company, Dept. P-9, 330 West 42nd Street, New York 18, New York, or to the Permutit Company of Canada, Ltd., Montreal.

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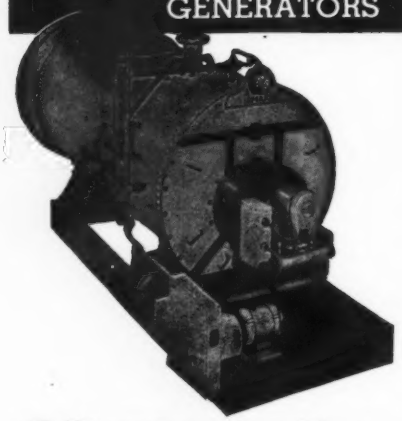

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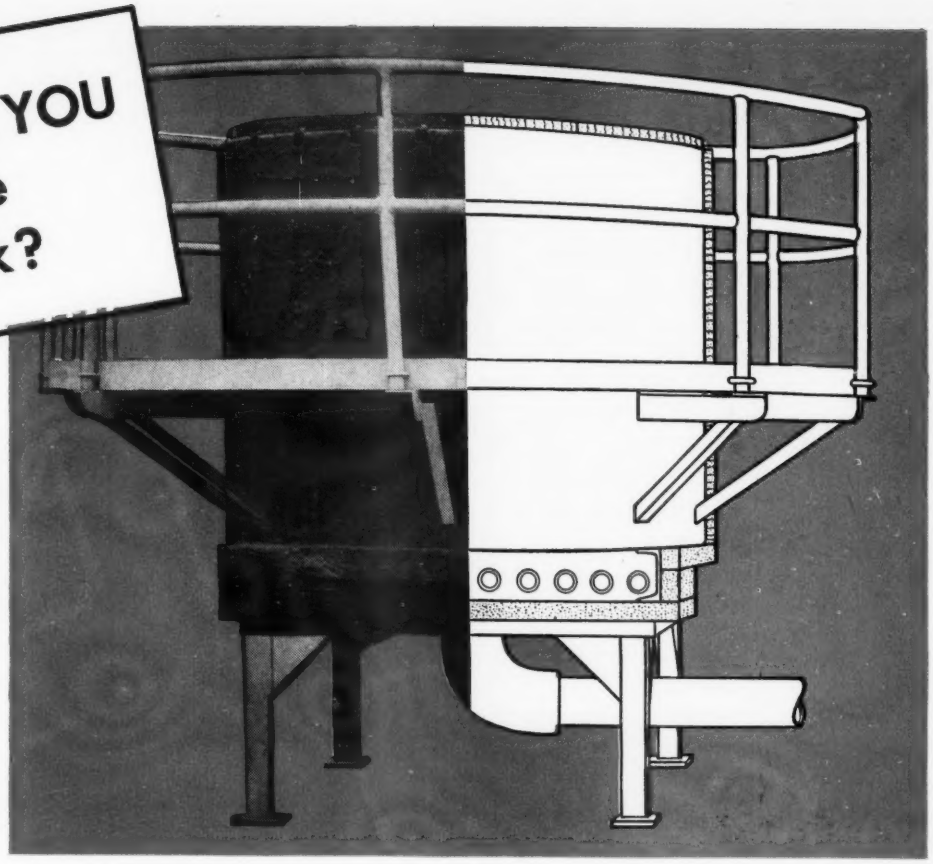
BUENOS AIRES, ARGENTINA: A 50,000-kw generator ordered by Compania Argentina de Electricidad, S. A., Buenos Aires, from Schenectady Works of General Electric Co, is expected to be delivered shortly. The 3000-rpm tandem-compound double-flow machine, sixth in a series of 50,000-kw generators installed by CADE, will be a duplicate of No. 5 generator installed in 1942 except for certain engineering improvements. The high-pressure section will have one 2-row wheel and 17 single-row wheels. Low-pressure section will have four double-row stages. The turbine drives main generator plus a 2500-kw auxiliary and exciters. The new unit will bring the firm's capacity up to over 300,000 kw.

PARIS, FRANCE: The French Government has put up $1,500,000 for joint research with the Belgians on gasification of unmined coal now being conducted near Liege. Mining experts of both countries believe that, if perfected, gasification methods might be successfully applied in many French and Belgian mines where thin seams make ordinary mining methods unprofitable.

BOMBAY, INDIA: A plan to create the largest manmade lake in the world, with a storage capacity of 33.3 million acre-ft (Boulder Dam holds 32 million) is the latest addition to India's imposing list of proposed multipurpose river projects. Since the cost of the project's first stage would be an estimated $100 million, matters of finance are likely to hold up work for some time. The dam, built across the Wainganga River in the Central Provinces, would have a central masonry section 154 ft high and 2400 ft long, flanked by 17.5 miles of earthen dikes. Surveys show that the reservoir would cover 640,000 acres, supply controlled irrigation to a million acres and make possible the generation of 600,000 kw.

Studies of methods for obtaining fresh water from the sea by distillation are under way in College of Engineering on Berkeley campus of University of California. The studies, started in 1947 for the War Dept under Wilfred F Langelier, professor of sanitary engineering, contemplate securing basic chemical data pertaining to concentrated sea water at boiling temperature. Attempts are being made to formulate the conditions that result in formation of calcium or magnesium-bearing scale, or of both. These studies of chemistry of boiling sea water indicate that a practical method can be developed of preventing scale formation on distillation units, without inducing corrosion. Field test runs with commercial units are contemplated.

How would YOU insulate this tank?



Outdoor storage tank in temperate climate must hold polymerized oil close to 80° F., winter and summer. Higher temperatures would vaporize naphtha solvent, lower would make oil too viscous. Tank is heated by thermostatically controlled 135-lb. steam in coils underneath. Which insulation would you specify?

- ☐ 3″ thick Magnesia blocks around heating coils, 2″ thick Magnesia on tank.
- ☐ 3″ thick Magnesia blocks around heating coils, 2″ thick corkboard around tank.

HERE'S WHAT THE ARMSTRONG ENGINEER RECOMMENDED

Steam will cost less if the heating coils beneath the tank are properly insulated. With 135-lb. steam in the coils, 3″ thick 85% Magnesia is adequate. Corkboard should not be used around the coils because the temperature of the steam (358° F.) is well above the top temperature limit of cork.

On the tank itself, insulation must do more than just conserve heat. It must hold the proper temperature inside the tank in hot summer weather, as no artificial cooling is used. Either 2″ of Magnesia or 2″ of cork could be used satisfactorily here. But because corkboard is more efficient than Magnesia in this temperature range, the Armstrong engineer recommended the extra protection of corkboard over the body of the 80° F. oil storage tank.

This job illustrates one of the big advantages you get with Armstrong's Contract Service. Armstrong engineers are familiar with both low-temperature and heat insulation materials and applications. Many jobs will operate more efficiently if both types of insulation are used. And Armstrong is well qualified to recommend the combination of materials that will give you the best insulation job.

Armstrong's Complete Contract Service provides engineering aid, skilled workmanship, and quality materials for any insulation job from 300° below zero to 2800° F.

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Over the years, the dependable performance and public acceptance of Timken bearings have made Timken-equipped products first choice throughout industry. Timken bearings in your product add a valuable sales feature. They build greater acceptance for your product among customers. When you specify bearings for your product, specify "Timken". And when buying new equipment, always look for the trade-mark "Timken" on the bearings. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

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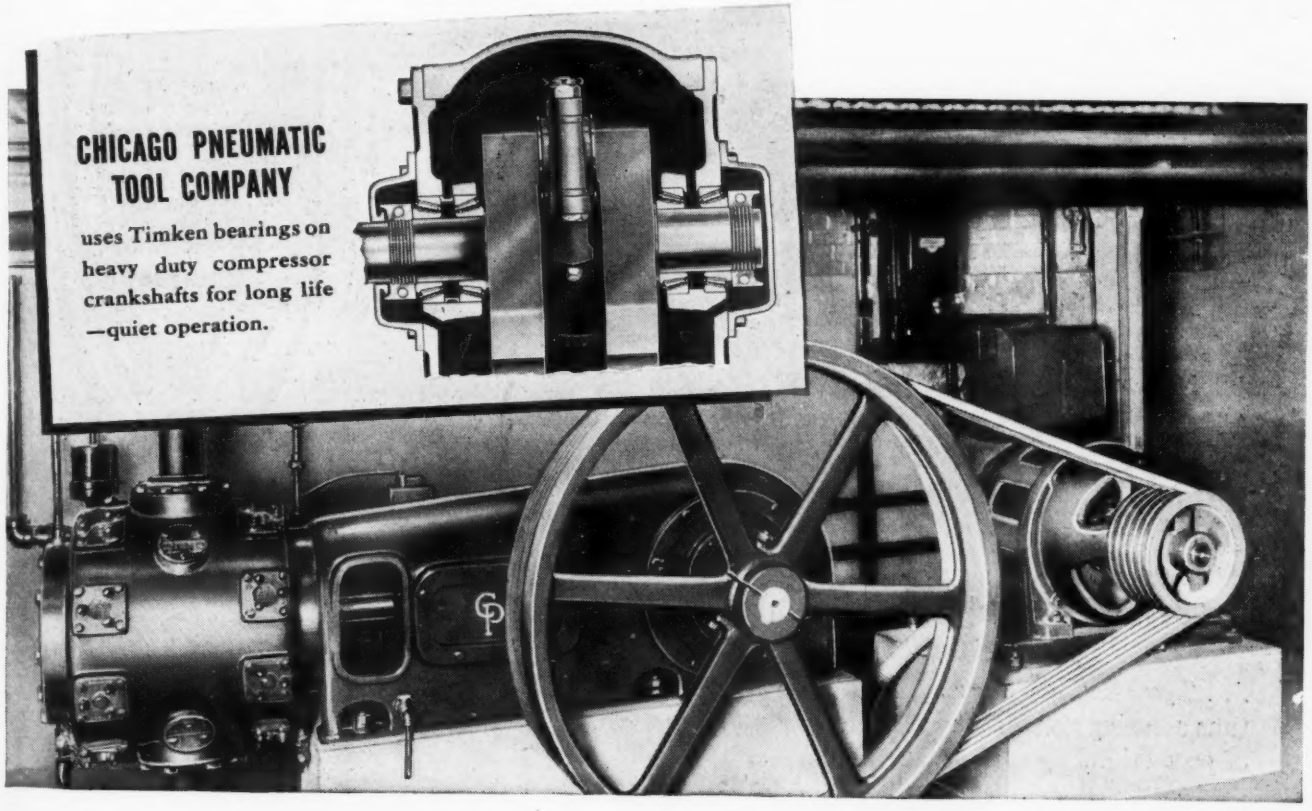
CHICAGO PNEUMATIC TOOL COMPANY

uses Timken bearings on heavy duty compressor crankshafts for long life —quiet operation.



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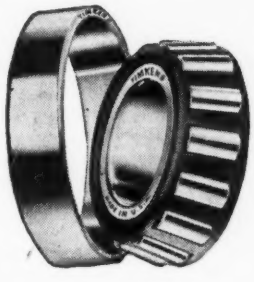

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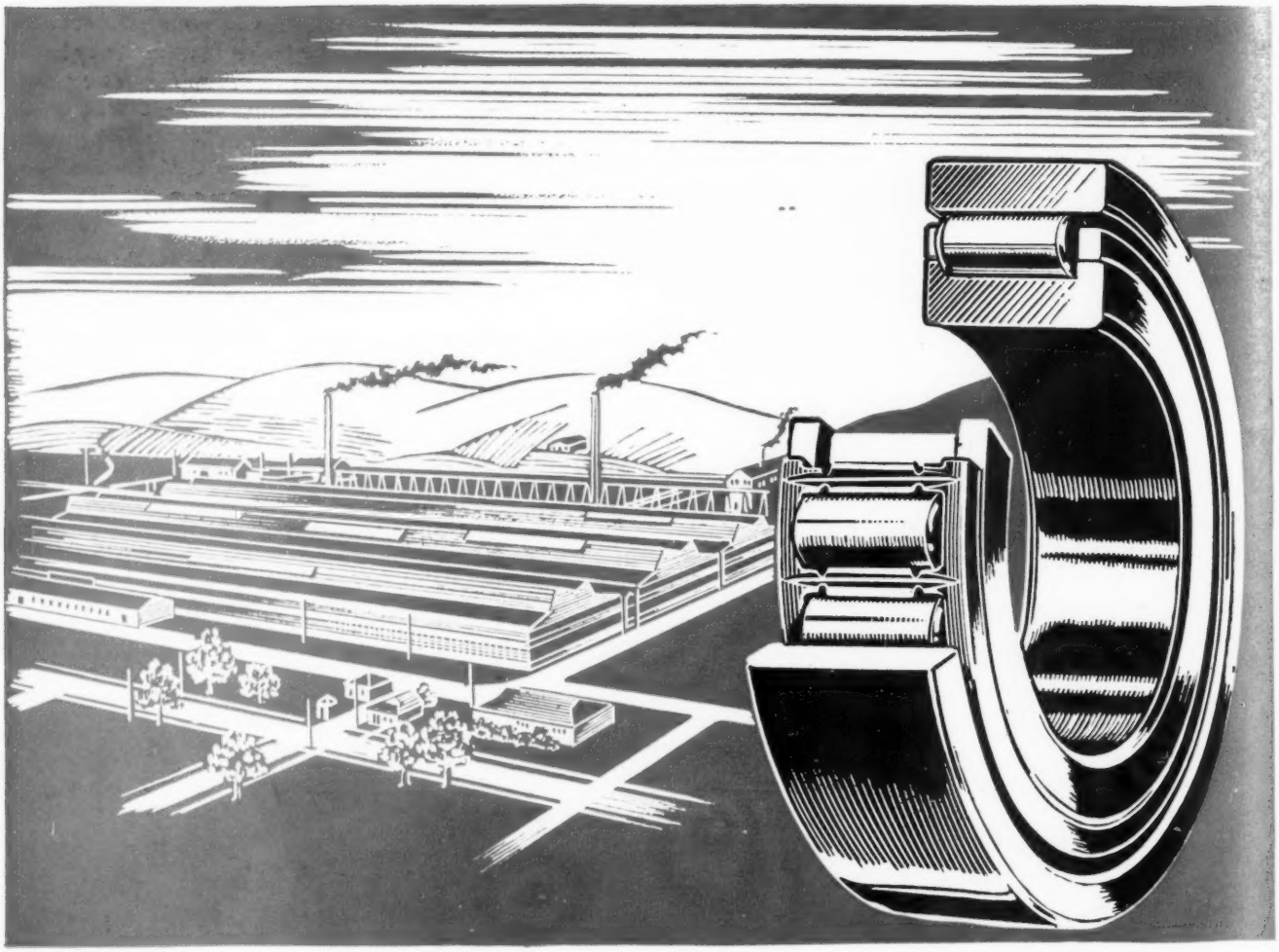

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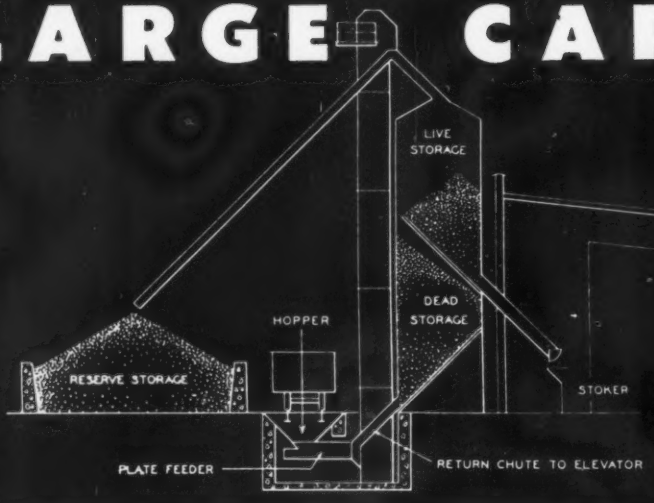
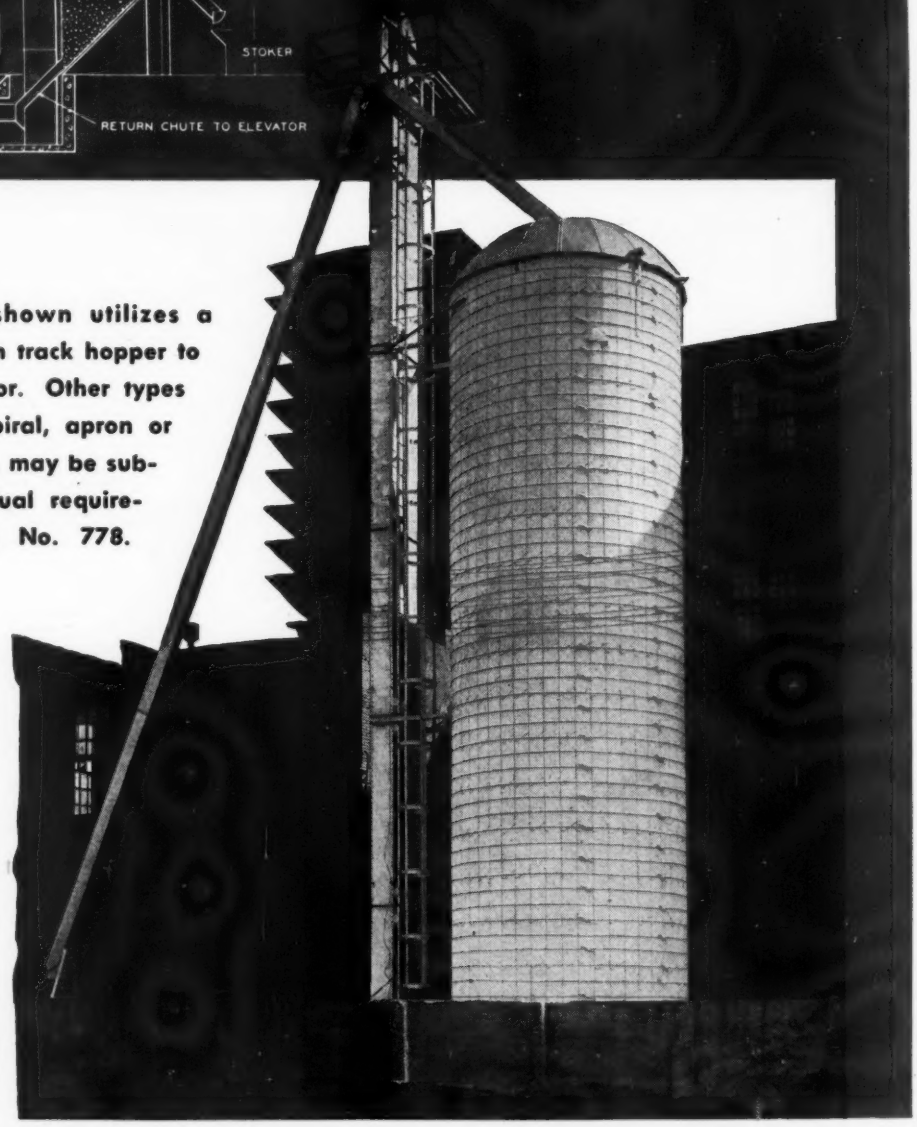


Arrangement shown utilizes a plate feeder from track hopper to the bucket elevator. Other types of feeders . . . spiral, apron or electric vibrating . . . may be substituted to fit individual requirements . . . Catalog No. 778.



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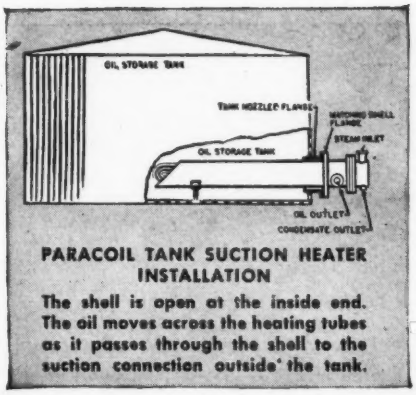

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The shell is open at the inside end. The oil moves across the heating tubes as it passes through the shell to the suction connection outside the tank.

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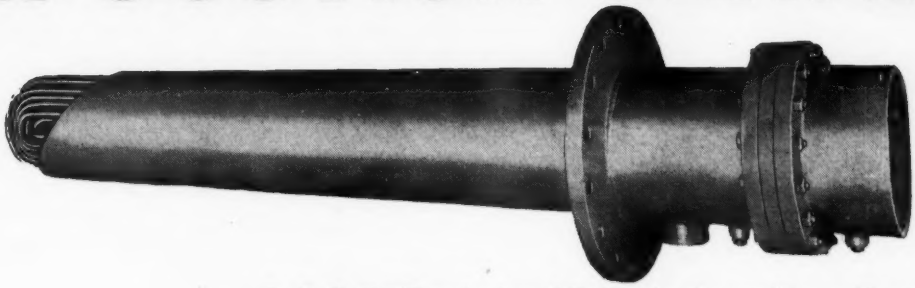
??? CONCERNED ABOUT LOSSES RESULTING FROM VOLUME SHRINKAGE AT LOW OIL DELIVERY TEMPERATURES? ...THEN INSTALL

Paracoil

TANK SUCTION HEATERS



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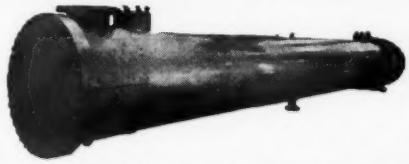

In addition to the Paracoil Tank Suction Heaters, we also design and fabricate Line Type Discharge Heaters of any capacity. Illustrated is a Paracoil Straight Tube Type Fuel Oil Heater for bulk station service—capacity 2,000 gallons per minute, No. 6 oil, 100°F to 160°F, steam at 15 psig. Weight 12 tons.

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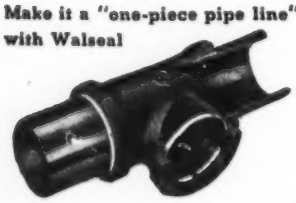

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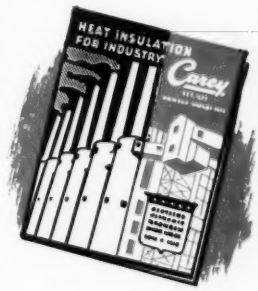

AVAILABLE TO HELP YOU! Carey's Complete Industrial Insulation Service is set up to give you everything from an insulation survey to a complete installation . . . to keep industry's BTU's on the job. Make full use of it at any time! Meanwhile you'll want to . . .

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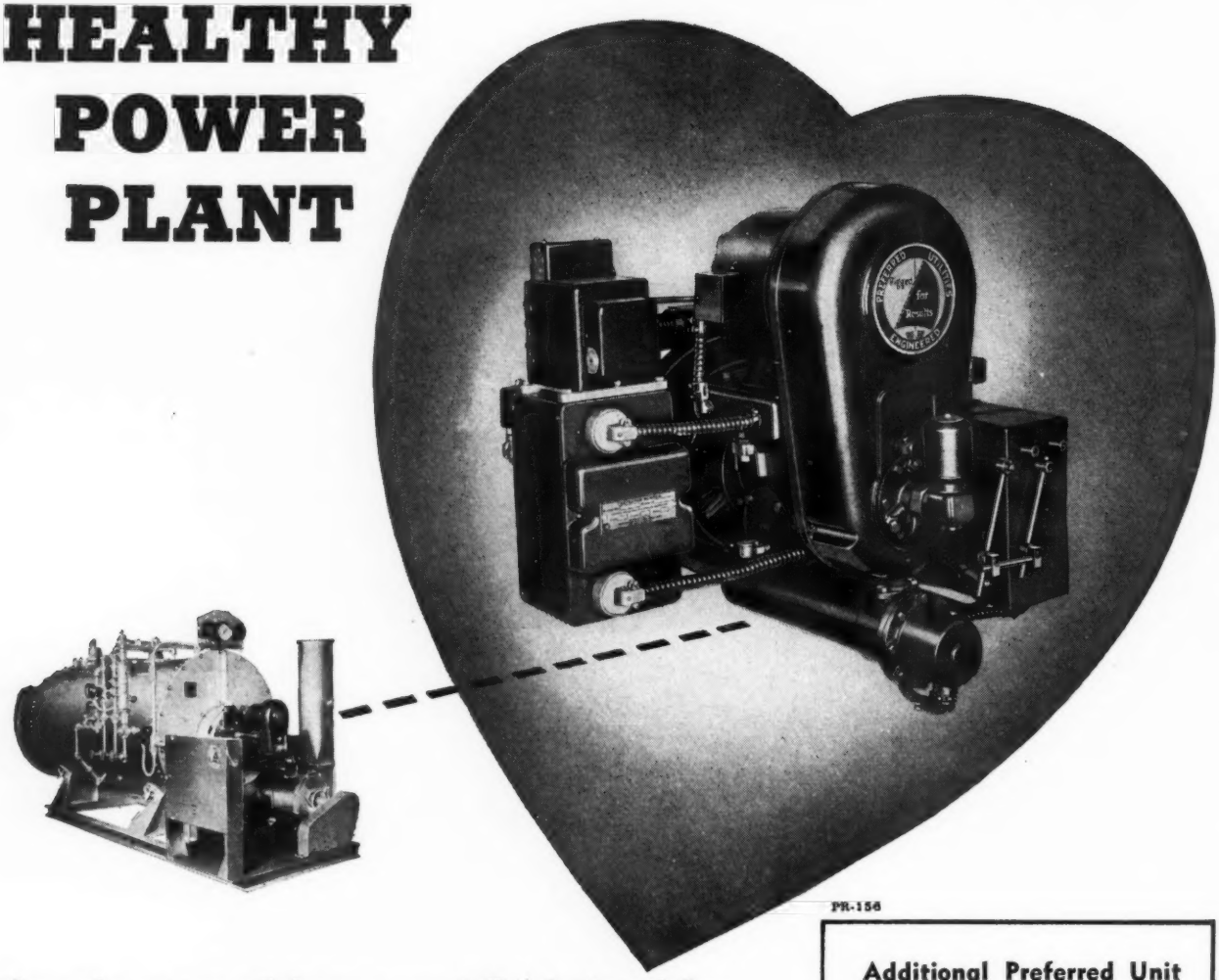

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1. Induced (pull-through) Draft — eliminates necessity of building expensive stacks. Only a simple vent to the outside air required. No escape of products of combustion into the boiler room.

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Four-pass units also available in all sizes for 250 p.s.i.g. design on special order. Write for complete details of these special units.

P-9-48

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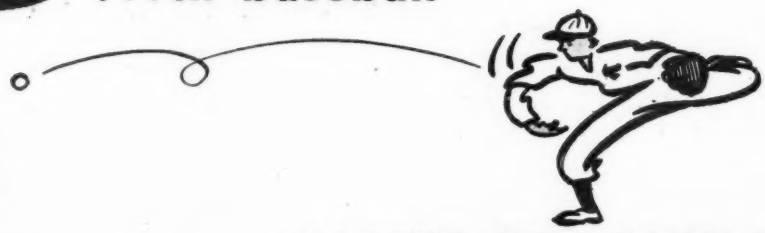

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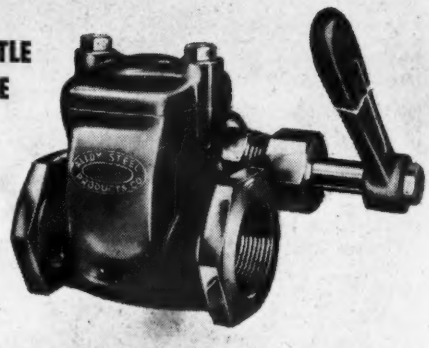
ALOYCO GLOBE CHECK VALVE No. 45A

ALOYCO LEVER THROTTLE GATE VALVE No. 120



The best pitcher in the big leagues would probably be only a second-rate catcher. This specialization in professional baseball is equally sound in the manufacture of corrosion-resistant valves. In order to make the very highest quality valves of stainless steels and related alloys, we have found it necessary to focus the entire facilities of our organization on this one product. We make nothing but valves—and we make them of nothing but corrosion-resistant alloys. The peculiarities of these metals make it necessary for the valve manufacturer to have long experience in their handling, to obtain maximum results.

It is this experience and skill that Aloyco offers to concerns in the process industries who require the very best in corrosion-resistant valves —from the standpoint of the best alloy for the purpose and correct mechanical design. Write us regarding your requirements.

ALOYCO

STAINLESS STEEL VALVES AND FITTINGS

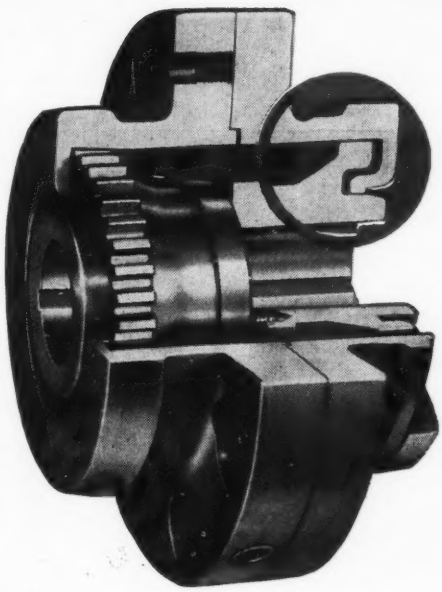
GATE, GLOBE, Y, CHECK, TANK, SAMPLING AND V-PORT VALVES
SCREWED AND FLANGED FITTINGS

ALLOY STEEL PRODUCTS COMPANY, INC.

1403 WEST ELIZABETH AVE. • LINDEN, N. J.

What's the BIG IDEA in Fast's Couplings?

THIS METAL TO METAL SEAL GIVES YOU EXTRA PROTECTION AGAINST COUPLING SHUTDOWNS



YOU can forget about coupling shutdowns once you've installed all-steel Fast's self-aligning Couplings in your plant. There's nothing to wear, nothing to fail in a Fast's. Even the load-carrying oil is protected by an exclusive "rocking bearing" (shown in circle). This bearing is *exclusive* in providing a positive metal-to-metal seal against wear-producing moisture, dust and grit. The bearing is also exclusive in its correctly engineered position which allows *freedom of movement* to compensate for misalignment because its *spherical* base has *the same axis* as the hub spline faces. No perishable packing rings are used. That's the "big idea" that helps Fast's Couplings give you uninterrupted power transmission!

We have a complete line of couplings for immediate delivery. When you buy any one of them, you buy years of top engineering experience, Koppers' high standard of workmanship and unexcelled coupling service that assures a ready source of spare parts, no matter how old your couplings may be. Result: longer machine life, lower upkeep costs, minimum shutdown losses. For full information on Fast's, the *original* gear-type coupling, fill out the coupon below and mail it to: Koppers Co., Inc., Fast's Coupling Dept., 249 Scott St., Baltimore 3, Maryland.

K KOPPERS

FAST'S *self-aligning* COUPLINGS

SEND FOR FREE CATALOG giving detailed descriptions, engineering drawings, dimension and capacity tables, and typical installation photographs for the many types of **Fast's Couplings**. Fill out this coupon and mail it to: **Koppers Co., Inc., Fast's Coupling Dept., 249 Scott St., Baltimore 3, Md.**

Name.....Position.....

Company.....

Street.....City.....State.....

LESS PARTS TO WEAR —

LESS WEAR ON PARTS

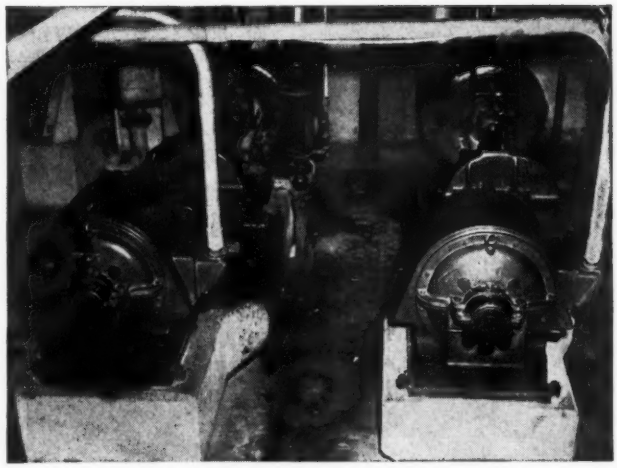
AMSCO-NAGLE PUMPS

CUT ASH HANDLING COST

Only three Amsco-Nagle Pump parts are subjected to the brutal punishing of furnace ash and slag as it is drawn from the power plant sump and delivered to the disposal area. *That's less parts to wear!* The anti-friction bearings are completely sealed off from the water end.

The three parts—end plate, impeller, and casing—are made of Amsco Manganese Steel. *That's less wear on parts!* "The toughest steel known" takes the roughest battering without fracturing . . . polishes and work hardens to as high as 550 Brinell to fight abrasion. (For scouring abrasion without shock stress, Brake Shoe's ABK Metal has proved highly economical.)

There are other reasons why this North Carolina power plant installed two Amsco-Nagle pumps. When repairs are eventually necessary, they're easier, less costly, less time-consuming. Parts are simplified and accessible for easy maintenance. End plate attaches with clamping ring or dogs. Impeller screws on. Supporting tubes on water end slip into sleeves on bearing housing for positive alignment. Stuffing box quickly reached, from above or below, between supporting tubes. Send for Bulletin 547-IP.



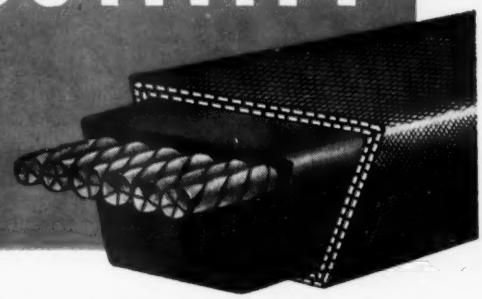
AMERICAN Brake Shoe COMPANY

AMERICAN MANGANESE STEEL DIVISION
CHICAGO HEIGHTS, ILL.

Foundries at Chicago Heights, Ill., New Castle, Del., Denver, Colo., Oakland, Calif., Los Angeles, Calif., St. Louis, Mo.
Offices in principal cities. In Canada: Joliette Steel Limited, Joliette, Que.

BULL DOG V-BELTS

HELP THE POWER INDUSTRY BUILD GREATER PRODUCTIVITY



In the present postwar rush for greater production, there's a noticeable trend toward bigger machines with higher operating speeds. Thus more work is turned out, and V-Belts have to carry heavier loads and stand more punishment.

Bull Dog V-Belts are designed to meet these present day conditions. They're entirely new — not a rehash of old construction, but a brand new product developed in BWH laboratories to do your job better, for a longer time, at lower cost. Test runs in leading industries prove that Bull Dog V-Belts more than measure up to laboratory predictions of amazingly increased efficiency.

In the short time they've been on the market, Bull Dog V-Belts have won phenomenal acceptance. Here's why:

EXCLUSIVE BWH Bull Dog Cords have greater tensile strength.

EXCLUSIVE BWH Compounds run cool, don't crack, or deteriorate under severe flexing.

EXCLUSIVE BWH Covers of heavy, bias-cut material resist wear, protect against dirt, grease, moisture.

Specify Bull Dog V-Belts on your next installation. You'll be glad you did, when you see maintenance cost sheets and production records!

HAVE YOU A JOB WHERE STAMINA COUNTS? Bring us your toughest problems. We're specialists in solving them. For all industrial rubber needs, look to BWH products for dependable ruggedness, BWH distributors for dependable service.

Another Quality Product of

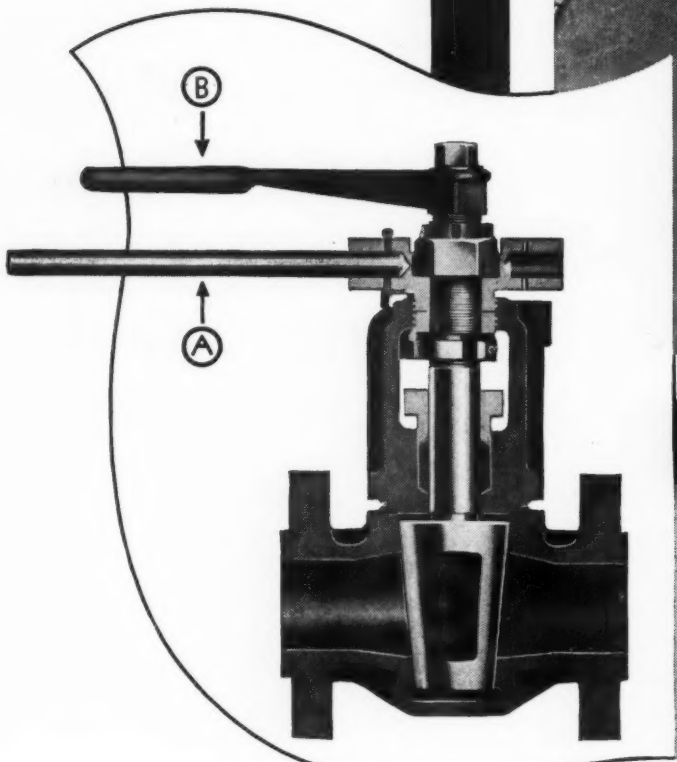
BOSTON WOVEN HOSE & RUBBER COMPANY

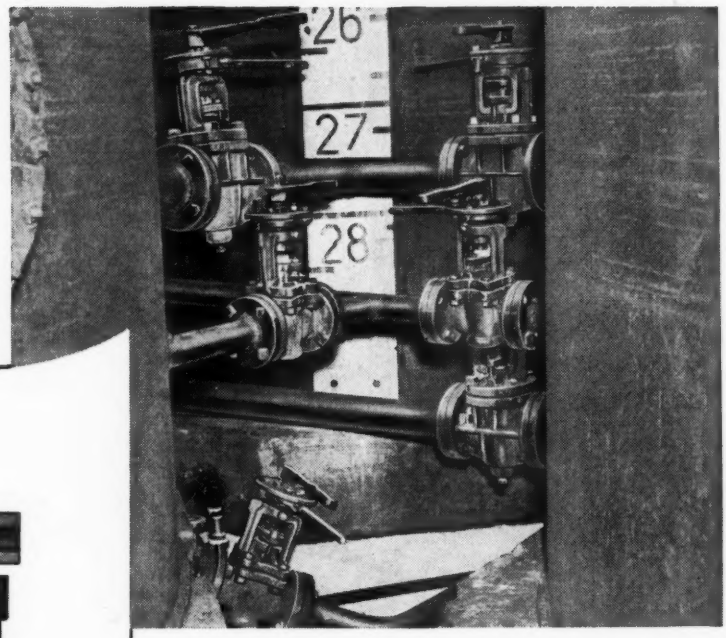
Distributors in all principal cities

PLANT: CAMBRIDGE, MASS., U. S. A. • P. O. BOX 1071, BOSTON 3, MASS.

"Instant, Stick-Proof Operation *at all Times, Under all Conditions*"

with HOMESTEAD Lever-Seald Valves





NOTE THESE OUTSTANDING FEATURES

1. Instant Stick-proof operation.
2. Quarter-turn fully opens or closes.
3. Positive seal without lubrication.
4. Seating surfaces always protected in both open and closed positions. Corrosion practically eliminated.
5. Unobstructed straight-line fluid flow.
6. All operating parts protected from damaging effects of service conditions and weather.

A powerful lever-and-screw device—built into each valve—prevents sticking and assures positive action at all times and under all conditions. Corrosive or viscous fluids, temperatures as low as 40° below Zero or as high as 1120° F., pressure or other adverse conditions that ordinarily cause valve failures, cannot affect the operation of Homestead Lever-Seald Valves.

Homestead Lever-Seald Valves operate faster too, 16 to 28 times faster than screw-stem-type valves. Seating pressure is first relieved with the lower lever "A" just enough to overcome friction. Then a quarter-turn of the upper lever "B" fully opens or closes the valve. Full seating pressure is again applied with the lower lever to make a positive, leakless seal.

Homestead Lever-Seald Valves can be furnished in combinations of metals and alloys to suit your requirements in sizes 1½" to 10", for pressure from vacuum to 1500 pounds.

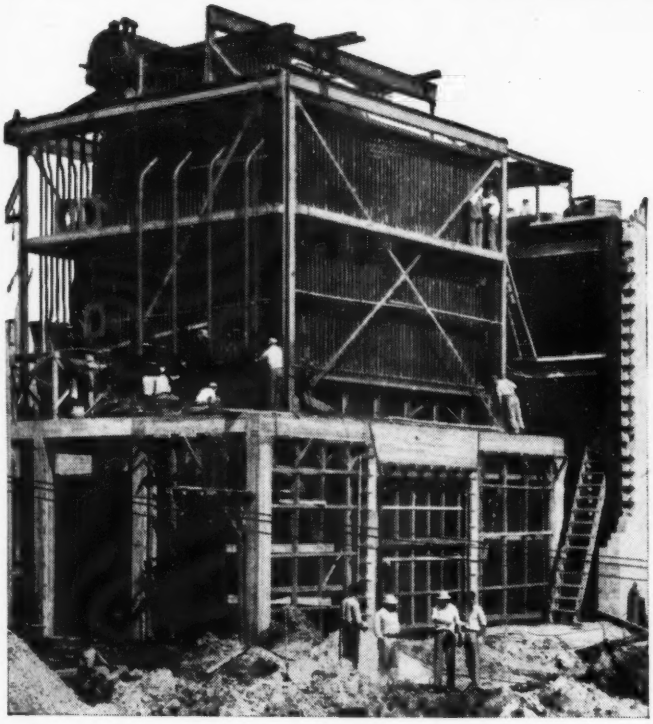
Write today for full information and copy of Section 3, Valve Reference Book No. 39.

HOMESTEAD VALVE MANUFACTURING CO.

P. O. BOX 210 CORAOPOLIS, PA.

DOWELL

SPECIALISTS IN SCALE AND SLUDGE REMOVAL WITH CHEMICALS



Clean That New Boiler!

REMOVE MILL SCALE AFTER ERECTION— The Chemical Way!

WHEN you install a new boiler, you'll find it to your advantage to specify removal of the mill scale *after erection*, using Dowell Chemical Scale Removal Service. The Dowell method eliminates much of the extra care required in the handling of previously sand-blasted or pickled tubes—*and* many power engineers have found that the *chemical* removal of mill scale from new boilers before the first firing results in more satisfactory boiler operation.

Unless removed, mill scale may retard heat transfer, slough off particles which abrade the system during operation, and act as a base for further corrosion.

Dowell engineers are selected for ability, trained in field and laboratory, and backed by the experience of thousands of successful jobs. They use mobile pumping equipment to fill the new boiler with specially selected liquid solvents which can reach wherever steam and water flow. They bring with them all necessary mixers, heaters and control equipment to perform the cleaning operation.

Put Dowell Chemical *Mill Scale Removal* Service in your new boiler specifications! Call on Dowell also for estimates of the cost of cleaning your present boilers, condensers, heat exchange equipment, water lines and water wells.

DOWELL INCORPORATED · TULSA 3, OKLAHOMA

SUBSIDIARY OF THE DOW CHEMICAL COMPANY

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New York 20	Buffalo 2	Kansas City 8	Mt. Pleasant, Mich.
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Atlanta	Louisville	Shreveport 23	

Long Beach, Oakland, Casper: Dowell Associate-International Cementers, Inc.

DOWELL

A SERVICE ORGANIZATION

Specify CMH EXPANSION JOINTS

...for compact, dependable pipe-line expansion control

Conservatively rated, precision-made CMH Expansion Joints offer new highs in dependability and trouble-free service. Compact corrugated assemblies cannot leak; there is no maintenance. Just install CMH Expansion Joints and forget about them.

CMH Expansion Joints are available in two types—Controlled-Flexing Joints with precision-mated control rings for higher pressures; Free-Flexing Joints for lower pressures. Both types are furnished in stainless steel or copper. Special expansion joints can be furnished for unusually high pressure ratings.

On your next job, whether it's a new installation or replacement of obsolete equipment, specify CMH Expansion Joints. Bulletin EJ-47, available on request, incorporates data for guidance in selecting the CMH Expansion Joints for your requirements. Both standard flanges and welded ends are furnished.

You'll find CMH Expansion Joints are simple to install.

"FLEXON" identifies CMH products, which have served industry for more than 45 years.

"the science of FLEXONICS . . ."the controlled bending of thin metals for use under varying conditions of temperature, pressure, vibration and corrosion"... is exemplified in the basic products of Chicago Metal Hose Corporation.

Write today for Bulletin EJ-47. Have specifications and operating data for CMH Expansion Joints at hand for ready reference.

CMH EXPANSION JOINTS

CHICAGO METAL HOSE CORPORATION

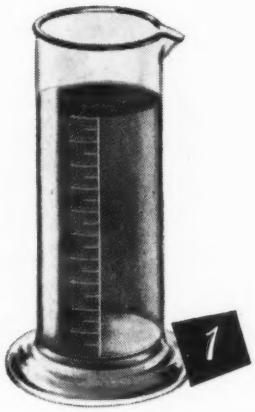
Expansion Joint Division • Maywood, Illinois

Plants at Maywood, Elgin and Rock Falls, Illinois

In Canada: Canadian Metal Hose Company, Limited, Brampton, Ontario

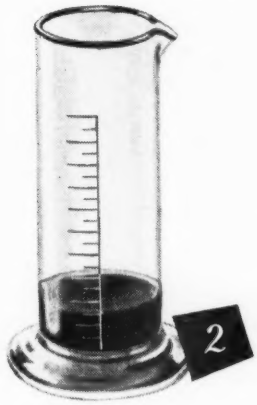
Gulfcrest is the only turbine oil that gets this *extra refining**

How the Alchlor Process* helps you keep your turbine system clean

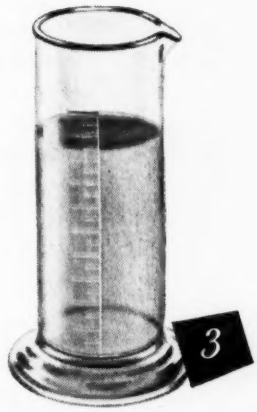


Gulfcrest is the only turbine oil that's Alchlor-processed.* This is an extra refining step. It makes Gulfcrest extra pure and extra efficient.

In Cylinder 1 you see the oil that will become Gulfcrest. It has already gone through the usual steps used in refining other turbine oils—but has not yet been Alchlor-processed.*



In Cylinder 2 you see the part — approximately 15% — discarded by the Alchlor Process.* This is the part that, when allowed to remain in turbine oil, is most likely to oxidize, increase neutralization number, and form sludge, emulsifiers, and harmful acids.



In Cylinder 3 you see the finished Gulfcrest—the incomparably pure lubricating oil that gives outstanding performance and helps keep steam turbine systems clean indefinitely. To make it even finer, special inhibitors are added to it — they give it even greater stability and protect against corrosion.

Call in a Gulf Lubrication engineer today and ask him to recommend the proper grade of Gulfcrest Oil to meet the specific requirements of your turbines. Write, wire, or phone your nearest Gulf office.

GULF OIL CORPORATION · GULF REFINING COMPANY

Division Sales Offices:

Boston · New York · Philadelphia · Pittsburgh · Atlanta
New Orleans · Houston · Louisville · Toledo

GULF INDUSTRIAL LUBRICATION

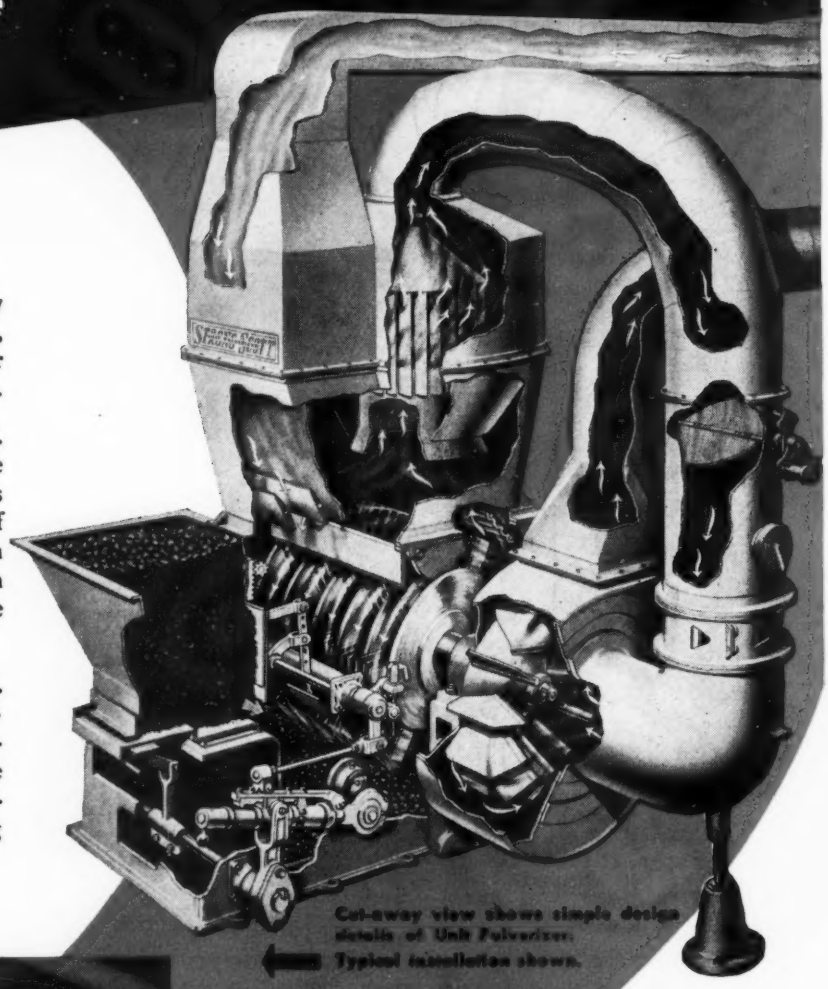
Burns ANY bituminous coal

Check these STRONG-SCOTT UNIT PULVERIZER FEATURES

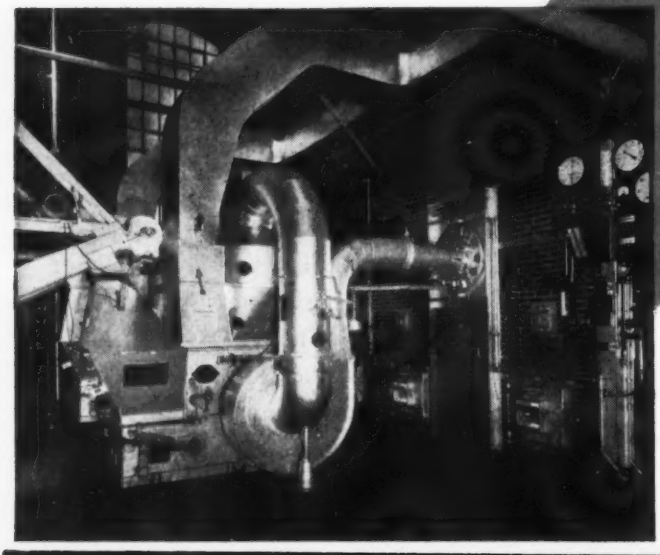
1. FIRES CONTINUOUSLY and uniformly under all conditions, with wet or dry, high or low grade coal, fine or irregular lumps up to 4". Rotor can't clog or jam.

2. REQUIRES MINIMUM MAINTENANCE. Has simple design and rugged, long-life construction . . . . . only one motor runs *entire* unit. All repairs made *outside* of furnace. Pulverizing wear mainly in rotor-blades and fan-blades, of such simple design user may easily provide and install his own replacements.

3. PROVIDES MAXIMUM FLEXIBILITY. Adjustable fuel feed, air supply and fuel-air mixture meets fluctuating steam demands easily. Handles soft coal, lignite or by-product pitch with only simple adjustments. . . . . Adapted to direct-firing boilers, kilns or driers.



Cut-away view shows simple design details of Unit Pulverizer.
Typical installation shown.



Backed by 50 years of manufacturing experience—23 in the combustion engineering field—STRONG-SCOTT has a long list of satisfied customers. More than 40% are repeat orders.

With installations in more than 200 American cities, you can easily visit one close by. You'll find our customers our best salesmen.

When you buy a STRONG-SCOTT Unit Pulverizer, you acquire *dependability, service,* and the *assurance* that the company stands behind every guarantee made. Your investment will return reduced steam costs and fuel bills.

WRITE FOR BULLETIN

Send for descriptive Bulletin for complete information. Names of customers in your vicinity furnished on request.

The STRONG-SCOTT Mfg. Co.

455 TAFT STREET N. E. • MINNEAPOLIS 13, MINN., U. S. A.

STRONG-SCOTT UNIT PULVERIZER

Maximum
BOILER OUTPUT WITH LEAST AMOUNT OF FUEL
THROUGH

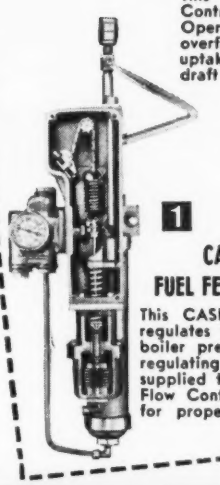
1. Automatic Regulation of Fuel Feed
2. Metered Air Needed for Combustion
3. A Constant Draft Maintained in the Combustion Chamber

Put this continuous automatic control to work for you in your boiler room. Get those important savings in smaller fuel bills, greater operating efficiency, and reduced maintenance. Increase the capacity of your present boiler.

The units shown here are available in a number of variations—combinations of these units can be made to give you complete automatic control with all of its benefits, whether you have a stoker, pulverizer, oil-burning or gas-firing equipment on your boilers. Size of your boiler or type make no difference.

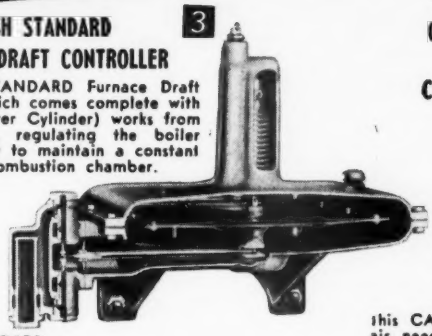
CASH STANDARD
AUTOMATIC COMBUSTION CONTROL SYSTEMS

• Bulletin No. 300 shows applications and gives details on CASH STANDARD Steam Plant Economy. Send for it.



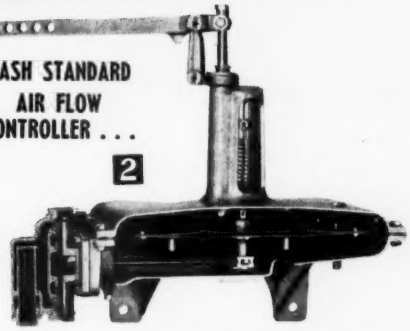
1 CASH STANDARD FUEL FEED CONTROLLER . . .

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion—hence, money saving.



3 CASH STANDARD FURNACE DRAFT CONTROLLER

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.



CASH STANDARD AIR FLOW CONTROLLER . . . 2

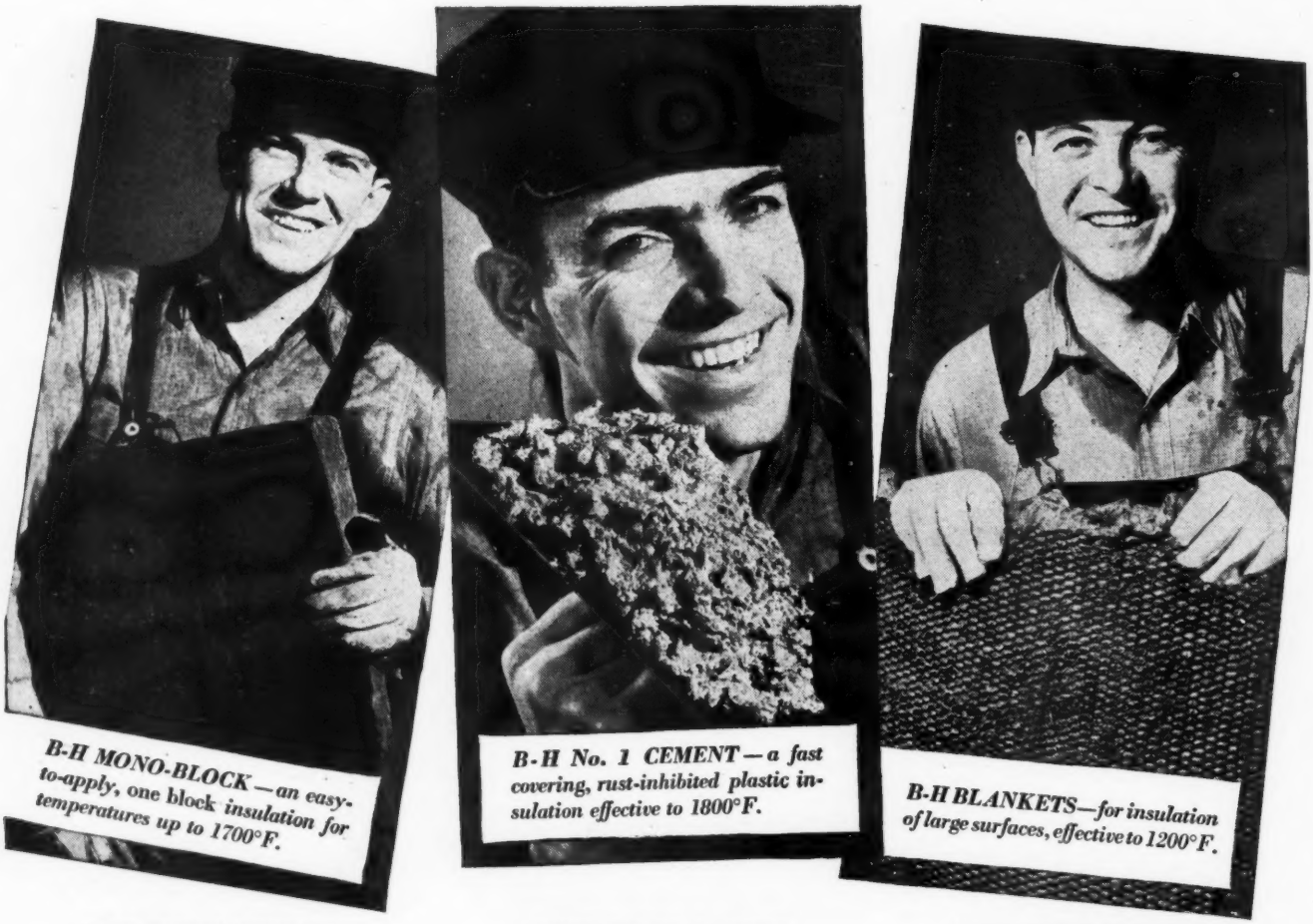
This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD
CONTROLS . . VALVES

3 Big Extras

when you insulate the BH way



B-H MONO-BLOCK — an easy-to-apply, one block insulation for temperatures up to 1700°F.

B-H No. 1 CEMENT — a fast covering, rust-inhibited plastic insulation effective to 1800°F.

B-H BLANKETS — for insulation of large surfaces, effective to 1200°F.

ONE BLOCK DOES IT!

With B-H Mono-Block, you eliminate the need for two types of block because it covers the full temperature range to 1700°F. Cuts to shape with a knife, fits snugly over rivet heads. And you stop heat loss with maximum efficiency because it's felted of black Rockwool.

GOES ON IN A JIFFY!

With B-H No. 1 Insulating Cement, you simply add water, mix and apply. It sticks instantly! Won't slide off bottom surfaces or roll up behind the trowel. Dries without cracking or peeling. Rust inhibitor prevents pitting and corrosion. Reclaimable up to 1200° F.

THE EDGES INTERLOCK!

With B-H Blankets, the soft fibre edges interlock to form one continuous blanket of insulation. Available in large sizes (16 sq. ft.) for quick and economical application on large surface areas. Suitable for vessels, tanks, towers, ducts, etc.

BALDWIN-HILL COMPANY
730 Breunig Avenue, Trenton, New Jersey
Send free sample of B-H Mono-Block ☐ B-H No. 1 Cement ☐
B-H Blankets ☐ and data book "Industrial Insulations".

NAME .....

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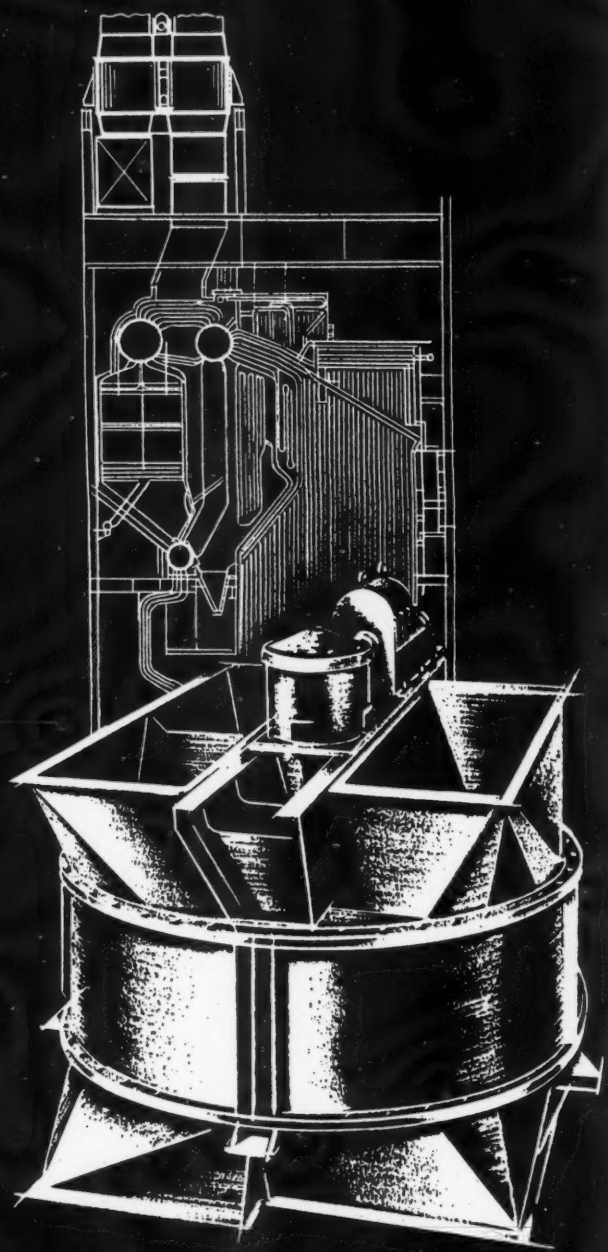
SEND FOR SAMPLES

Baldwin-Hill

Specialists in Thermal Insulation

Designed for Preheat

where fuel is a problem



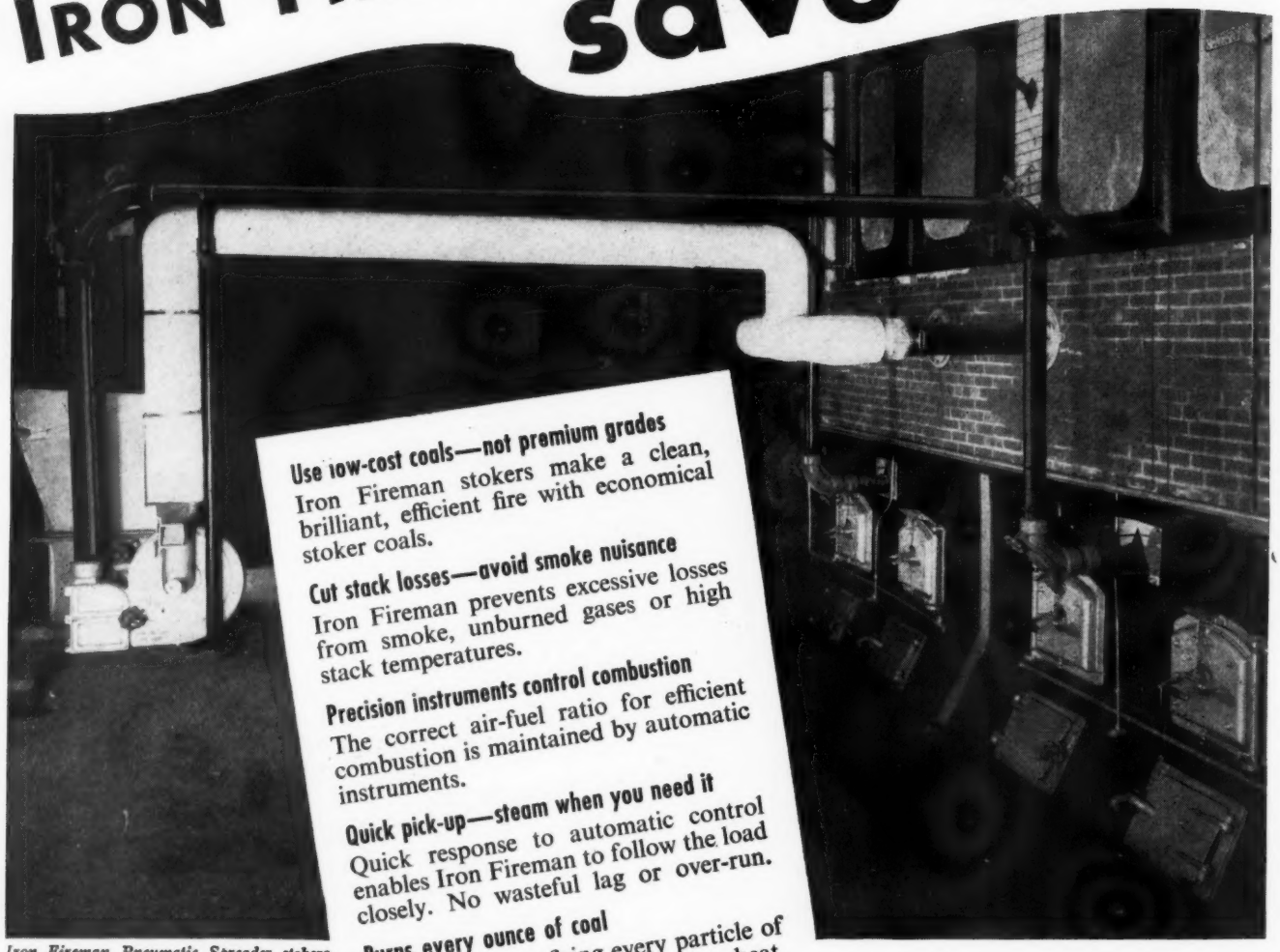
The Ljungstrom Air Preheater simplifies the problem of burning such fuel as oil, low-grade coal, bagasse or paper-mill refuse.

While plans for steam generation plants are under consideration, investigate the possibilities of the Ljungstrom. The specialized experience of Air Preheater engineers is at your disposal, to aid in effecting the most economic heat recovery from flue gases.

The Air Preheater Corporation

EXECUTIVE OFFICES: 60 East 42nd Street, New York 17, N. Y. • **PLANT:** Wellsville, N. Y.

8 ways IRON FIREMAN STOKERS save coal



Iron Fireman Pneumatic Spreader stokers convey steam size coal from bunker or hopper to boiler on stream of pre-heated air.

Use low-cost coals—not premium grades
Iron Fireman stokers make a clean, brilliant, efficient fire with economical stoker coals.

Cut stack losses—avoid smoke nuisance
Iron Fireman prevents excessive losses from smoke, unburned gases or high stack temperatures.

Precision instruments control combustion
The correct air-fuel ratio for efficient combustion is maintained by automatic instruments.

Quick pick-up—steam when you need it
Quick response to automatic control enables Iron Fireman to follow the load closely. No wasteful lag or over-run.

Burns every ounce of coal
In Iron Fireman firing every particle of combustible material is turned into heat. No excessive loss through coke in ash.

Steady steam pressure with fluctuating load
Pressure gauge stays right on the beam even when steam demands fluctuate between wide limits.

Get up to 50% more steam from boilers
Iron Fireman efficiency steps up boiler capacity. In many plants formerly pressed to the limit Iron Fireman firing has released boilers for standby use.

Cut fuel losses while fires are banked
Iron Fireman refueling instruments keep fuel bed ready for instant use, without fuel waste.

Know before you buy what your savings will be

Before you buy, Iron Fireman makes a scientific analysis of your present steam operation, then gives you a written estimate of the fuel savings and increased steam output you'll get. You know *before* you modernize with Iron Fireman stokers how much they'll save for you.

Send for your free copy of illustrated booklet "Iron Fireman Automatic Coal Stokers for Heating and Power"—Write your name on the margin of this advertisement and mail to Iron Fireman Mfg. Co., 3237 W. 106th St., Cleveland 11, Ohio. Other plants in Portland, Oregon; Toronto, Ontario. Dealers everywhere.

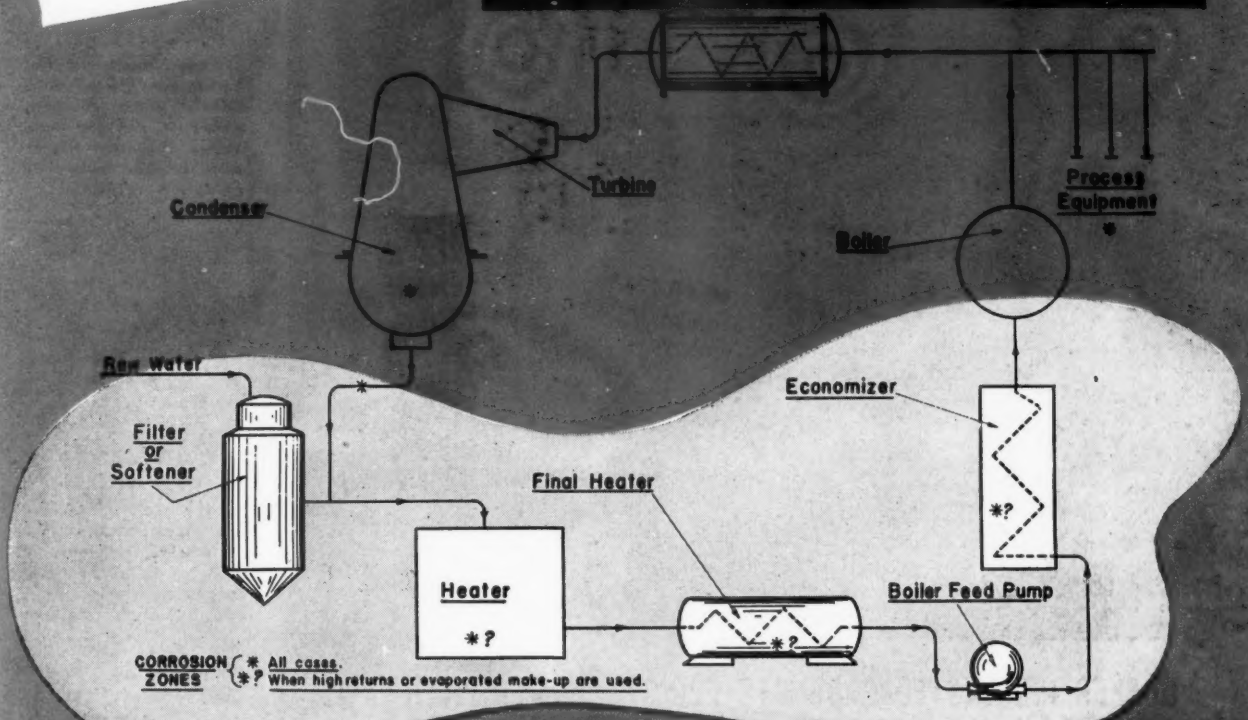
THE IRON FIREMAN

IRON FIREMAN

HEAVY DUTY STOKERS AND OIL BURNERS

Is your plant operation suffering from Water Treatment problems—

in the Feedwater System?



Serious production delays and high maintenance costs can result from either or both of the following problems commonly encountered in feedwater systems:

CORROSION—May result from presence of dissolved oxygen or from either high or low alkalinity. A type of failure sometimes referred to as corrosion-erosion is especially important in the case of feed pumps.

FEEDLINE DEPOSITS—Water entering the system often contains suspended material that may lead to deposits. More commonly, however, deposits are caused by precipitation of bicarbonate hardness as the water is heated, or through precipitation by water treatment chemicals.

In order to eliminate both of these problems, proper water treatment must be instituted. This may range from internal treatment, which is necessary in practically all cases, to pretreatment, which is often required in addition. For the elimination of corrosion, corrective steps may range from simple pH regulation to re-circulation of boiler water. Proper deaeration and gas removal also are required. For the elimination of deposits, proper feeding of internal boiler water treatment must be practiced and in many cases, continuous addition of organics may be necessary.

Some of these difficulties are probably present in your plant. Your local Drew Engineer will be glad to call and discuss corrective measures.
No obligation.

POWER DREW CHEMICALS

E. F. DREW & CO. INC.
15 E. 26th ST., NEW YORK 10, N. Y.
Representatives in all key cities

BOILER WATER TREATMENT
COOLING WATER CONDITIONING

OVEN TEST COOKS UP LONGER LASTING PRODUCTS

QUAKER PRE-TESTED PRODUCTS FOR THE POWER FIELD ARE PERFORMANCE-PROVED THROUGHOUT THE NATION

It may be called the "Oven Test," but to the buyer of Quaker Rubber Products it means producing rubber with the ability to withstand heavy static loads.

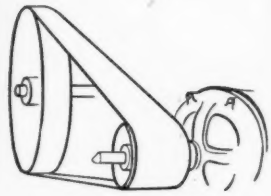
In making Quaker Rubber Hose it results in compounds of controlled specifications that will hold couplings over long periods of time . . . prevent hose from relaxing and allowing couplings to loosen. In packings, this pre-testing assures finished products that will hold their shape, will not relax, readily withstand pressures without the danger of blowouts.

This is only one of eighteen rigid tests that raw materials and finished products *must* pass before receiving the Quaker stamp of approval. Pre-testing provides quality and long service . . . assures worthwhile dividends for you through higher plant efficiency, lower operating costs. Call in your nearest Quaker distributor for hose, belting and packings.

QUAKER RUBBER CORPORATION

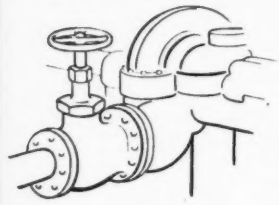
PHILADELPHIA 24, PA. • New York 7 • Cleveland 15 • Chicago 16 • Houston 1
Western Territory
QUAKER PACIFIC RUBBER CO. • San Francisco 10 • Los Angeles 21 • Seattle 4

WHAT QUAKER Pre-Tested Products mean to the Power Field



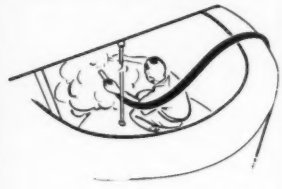
STEADY GRIP . . . LESS SLIP

Quaker V-belts and flat belting are pre-tested to provide plenty of grip, plenty of pull for more power. Pre-tested rubber stays flexible, withstands aging and abrasion.



TIGHT-SEALING OPERATION

Quaker pre-tested packings for all purposes keep pressure in . . . stop leaks on valve stems, piston rods, flanges. Made of pre-tested materials for long life.



LONG SERVICE AT HIGH PRESSURE

Quaker hose provides low-cost handling of steam, air, liquids, volatiles. Pre-tested rubber remains pliable, flexes easily, combats breakdown.

•

ENGINEERING SERVICE

When belting, hose, and packing problems bog down efficiency in your plant, call your Quaker Distributor for a quick solution.

QUAKER RUBBER CORPORATION · PHILADELPHIA, PA. · QUALITY SINCE 1885 · REG. U.S. PAT. OFF.

QUAKER RUBBER PRODUCTS

custom made for every industrial use

The First Step To Lower Power Costs

SINCE the yearly cost of coal often exceeds the cost of boiler equipment, many farsighted power plant designers, owners and operators are conducting fuel investigations.

The results are used as a basis for design specifications for new plants or when modernizing existing plants. Often only minor changes are necessary to materially widen fuel selection in existing plants—enabling them to purchase the best coal value available under all market conditions.

The Engineering-Research Department of the Ohio Coal Association will be glad to furnish, without obligation, helpful information to power plant designers, operators, and owners on how to conduct a fuel investigation for lower power costs.

THIS BOOKLET contains charts, illustrations, diagrams and technical data on how to conduct a fuel investigation for lower power costs and other helpful information of interest to power plant designers, operators and owners. Free on request—write today.

OHIO COAL ASSOCIATION

ROCKEFELLER BUILDING • CLEVELAND 13, OHIO

-AND HERE'S ANOTHER "FIRST" BY DODGE!

Here is another Dodge development which simplifies and improves power transmission machinery... the Rolling Grip Clutch. Toggles are *eliminated* by employment of ball and wedge principle.

Heavy power-transmitting pressure on the friction disc is developed by a circle of hardened steel balls which are forced into a wedge-shaped groove by the sliding cam.

The "wedge" of cam and groove contours multiplies the force exerted on the shifter collar into a powerful force on the friction disc.

Engagement is easy and positive —smooth as a rolling ball. Great flexibility, ease of control and extreme ruggedness are provided in this modern, compact unit.

Available in Bolted Plate or Gear Tooth Plate series—in sizes from .38 H.P. to 21.2 H.P. at 100 R.P.M. Write for special bulletin, A282.

DODGE MANUFACTURING CORPORATION
Mishawaka, Indiana

ROLLING GRIP CLUTCH

DODGE
of Mishawaka, Ind.

CALL THE TRANSMISSIONEER

He is your local Dodge Distributor—factory trained—qualified to suggest ways to improve your machine performance, increase production. Look for his name under "Power Transmission Equipment" in your classified phone book.

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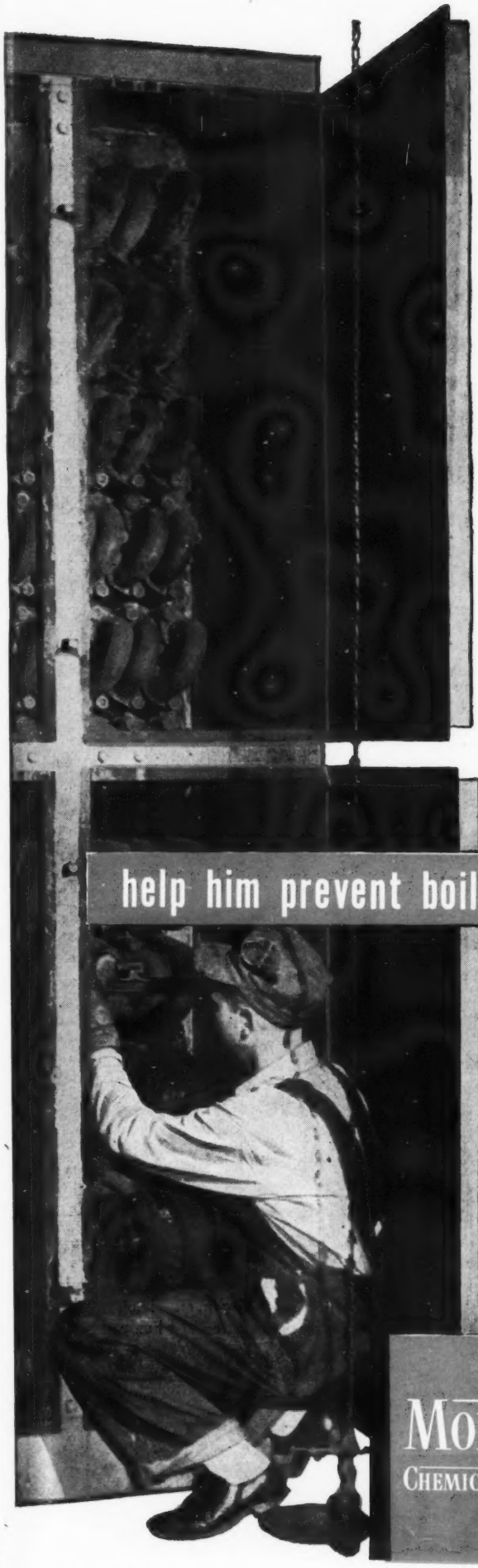
NAME PLATES

FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY, ETCHING COMPANY OF AMERICA, 1520 MONTANA STREET, CHICAGO 14, ILLINOIS



help him prevent boiler-room waste . . . with SANTOSITE

Santosite is particularly valuable in preventing boiler room waste by effectively controlling oxygen corrosion. Added to boiler feed water, it removes all traces of residual oxygen, by combining with it to form sodium sulfate, which is water-soluble under boiler conditions and therefore does not contribute to the formation of sludge.

The Santosite treatment is simple—Merely maintain a residual of 30 parts to 1,000,000 parts of water. This affords normal protection—also it guards against the occasional appearance of oxygen—brought about by leaks in condensers, pump-packing glands, vacuum-return heating systems, or by unexpected overloads.

Further information and technical data on Santosite are available in Monsanto Technical Bulletin No. O-26, "Santosite for Removing Oxygen from Boiler Feed Water." For your copy, write to MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second Street, St. Louis 4, Missouri. Use the convenient coupon if you prefer.

Santosite: Reg. U. S. Pat. Off.

MONSANTO
CHEMICALS AND PLASTICS

MONSANTO CHEMICAL COMPANY PR-2
Organic Chemicals Division
1700 South Second Street, St. Louis 4, Missouri

Please send me a copy of the Techincal Bulletin on Santosite.

Name_____ Title_____

Company_____

Address_____

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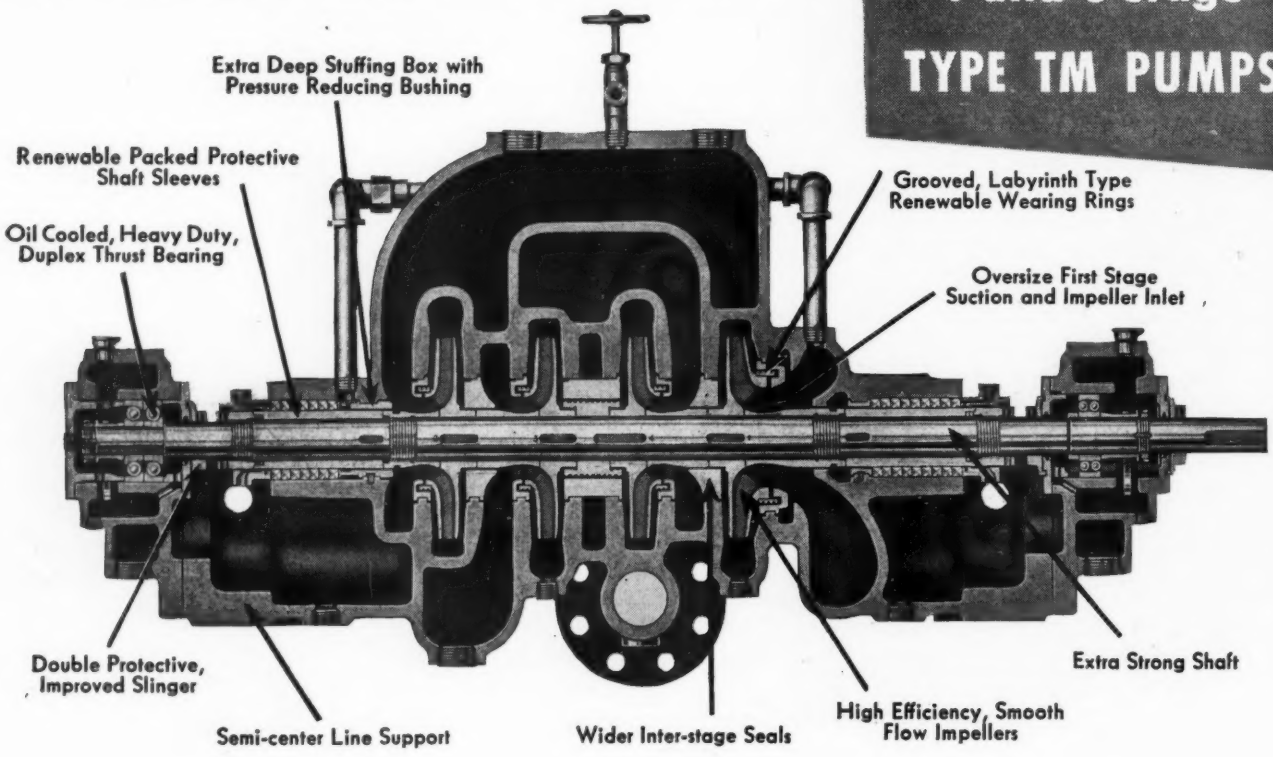
SERVING INDUSTRY . . . WHICH SERVES MANKIND

Here's why you get longer life, higher efficiency, greater dependability from

WARREN
4 and 6 stage
TYPE TM PUMPS


Extra Deep Stuffing Box with Pressure Reducing Bushing
Renewable Packed Protective Shaft Sleeves
Oil Cooled, Heavy Duty, Duplex Thrust Bearing
Grooved, Labyrinth Type Renewable Wearing Rings
Oversize First Stage Suction and Impeller Inlet
Double Protective, Improved Slinger
Semi-center Line Support
Wider Inter-stage Seals
High Efficiency, Smooth Flow Impellers
Extra Strong Shaft

Radial and Axial Balance

Increased dependability, efficiency and life result from Warren TM pumps being in radial balance as well as axial balance. Radial balance is achieved by having half the number of stages discharging up and the other half down, thus eliminating dangerous shaft deflections which cause excessive wear at all close fits, reducing efficiency. Axial thrust is controlled by mounting impellers back-to-back, thus avoiding troublesome balancing drum or thrust plate.

Lower Maintenance

Every possible care has been taken in design and construction of Warren Type TM Pump to insure utmost dependability and highest efficiency through elimination of danger of failure and reduction of wear to absolute minimum. Thus low maintenance is assured. Wherever wear is inevitable after long service, renewable parts are provided and all parts are easily accessible. Horizontally split case allows complete access to rotor, or its removal, without disturbing main connections.

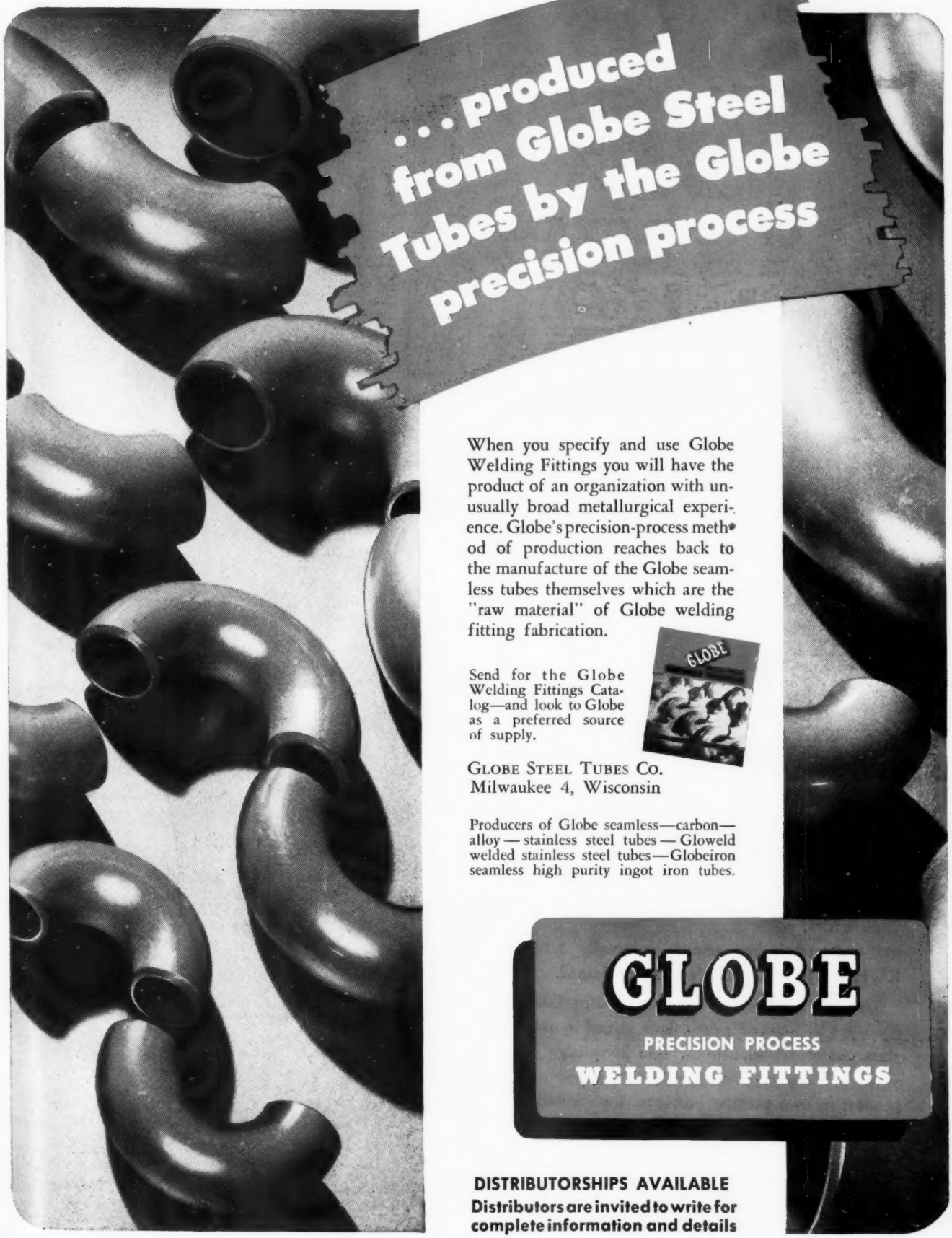
Send for bulletin #241 . . . . . or better, send an outline of your pumping problem and get a Warren recommendation.

Mohawk Carpet Mills, Inc., Amsterdam, N. Y., is one of the outstanding industrial concerns where Warren Pumps are on the job. Here you see a Warren TM 4 stage pump on boiler feed service, 500 # p. s. i. delivering 500 g. p. m. Mohawk has since purchased a second Warren TM Pump.

Warren Steam Pump Company, Inc.
WARREN, MASSACHUSETTS P-15

WARREN PUMPS

NOW GLOBE WELDING FITTINGS



. . . produced from Globe Steel Tubes by the Globe precision process

When you specify and use Globe Welding Fittings you will have the product of an organization with unusually broad metallurgical experience. Globe's precision-process method of production reaches back to the manufacture of the Globe seamless tubes themselves which are the "raw material" of Globe welding fitting fabrication.

Send for the Globe Welding Fittings Catalog—and look to Globe as a preferred source of supply.

GLOBE STEEL TUBES CO.
Milwaukee 4, Wisconsin

Producers of Globe seamless—carbon—alloy—stainless steel tubes—Gloweld welded stainless steel tubes—Globeiron seamless high purity ingot iron tubes.

GLOBE
PRECISION PROCESS
WELDING FITTINGS

DISTRIBUTORSHIPS AVAILABLE
Distributors are invited to write for complete information and details

A Cottrell Precipitator Installed by Research Corporation

WILL COLLECT OVER

95%

OF YOUR FLY ASH

A Research Corporation Cottrell will effectively clean stack gases by removing over 95% of all the different size fly ash particles suspended in the gas.

It will operate with a low draft loss, averaging only a few tenths of an inch of water across the Cottrell. The electrical power required for energizing the Cottrell is extremely low, amounting to only .5 to 1.0 KWH per 100,000 cubic feet of gas cleaned.

The *plus* efficiency of Research-installed Cottrells is assured by Research's experience gained in over 35 years and 1100 installations. This knowledge is essential to successful dust control, for every application presents its own peculiar problems. Each installation must be individually engineered.

Research-Cottrells can be installed to furnish any degree of efficiency desired, and to handle any volume of boiler gas. Full information is presented in an interesting 28-page bulletin. Write for your copy today.

Research Corporation Installations

47 CARBON BLACK PLANTS
200 METALLURGICAL INSTALLATIONS
203 ACID PLANTS • 34 PAPER MILLS
262 DETARRING INSTALLATIONS
195 POWER STATIONS
71 STEEL PLANTS • 95 OIL REFINERIES
AND MISCELLANEOUS INSTALLATIONS

RESEARCH CORPORATION

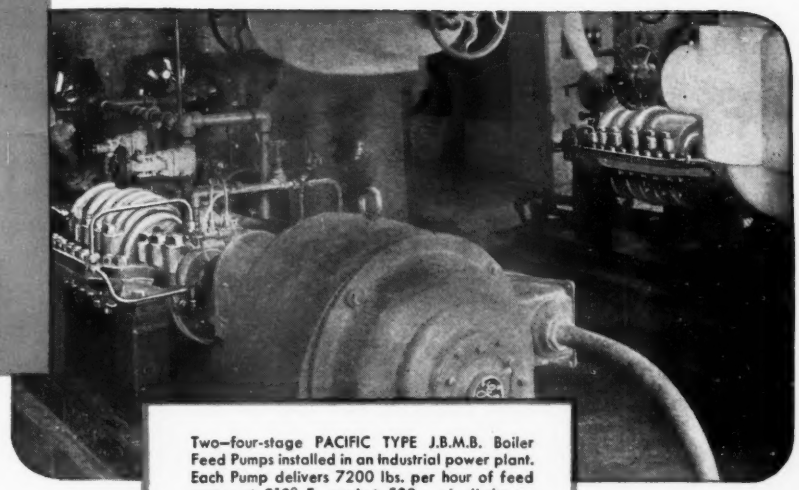
405 Lexington Avenue, New York 17, N. Y.

122 South Michigan Avenue, Chicago 3, Illinois

Your PACIFIC TRIO

TYPES I-A-JB *Precision Built*

For DEPENDABLE—UNINTERRUPTED BOILER FEED SERVICE IN POWER PLANTS—LARGE OR SMALL

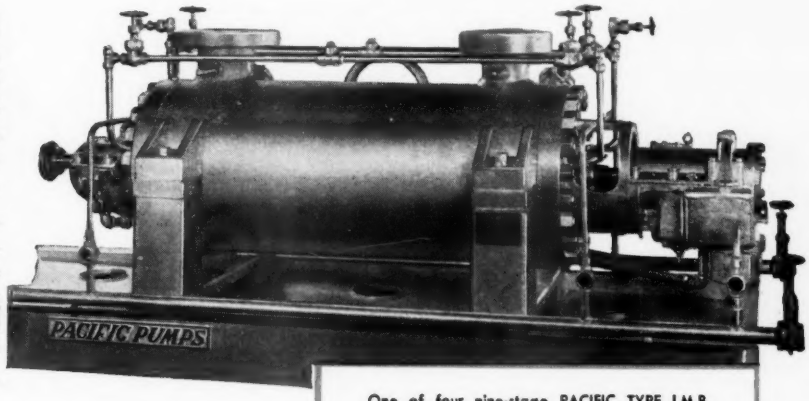


TYPE JB ➤ Two—four-stage PACIFIC TYPE J.B.M.B. Boiler Feed Pumps installed in an industrial power plant. Each Pump delivers 7200 lbs. per hour of feed water at 212° F against 500 p.s.i. discharge pressure.

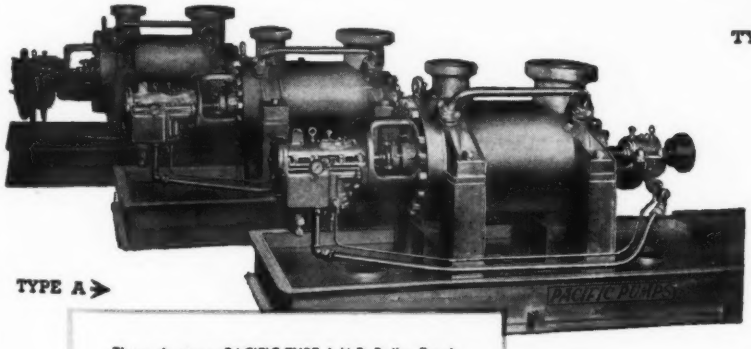
EXPERIENCE ★ For 23 years PACIFIC have designed and built centrifugal pumps for high-pressure—high-temperature service. The knowledge of this experience is incorporated in the PACIFIC TRIO—TYPES "I"—"A"—and "JB" Boiler Feed Pumps.

1925 ★ The first PACIFIC Centrifugal Pumps for High Pressure—4 units each for 180,000 lbs. per hour—175° F.—2100 p.s.i. discharge. Design featured RING TYPE JOINTS—METAL-TO-METAL SEAL to prevent interstage leakage, SUCTION PRESSURE on both Packing Boxes.

1925 to 1948 ★ a period of refinement. Included was the PACIFIC "Floating Seal"—a simple, effective pressure break-down and balancing device, making possible for PACIFIC in 1943 to build pumps to deliver 325,000 lbs. per hour of water at 545° F. against 1388 p.s.i. discharge pressure.



TYPE I ➤ One of four nine-stage PACIFIC TYPE I.M.B. Boiler Feed Pumps shipped in October 1947 for a large central station. Each pump to deliver 657,600 lbs. per hour of feed water at 220° F. against 1700 p.s.i. discharge pressure.



TYPE A ➤ Three six-stage PACIFIC TYPE A.M.B. Boiler Feed Pumps now being installed in a municipal power plant. Each pump to deliver 200,000 lbs. per hour of feed water at 287° F. against 1,000 p.s.i. discharge pressure.

DESIGN ★ embodies features proved in service—dynamic—radial and axial balance—ring-type high pressure joints—positive seal against interstage leakage—low pressure on Packing Boxes.

MATERIALS ★ the right materials for the service, Cast Steel Cases for medium pressures, forged Steel Cases for high pressures; (when necessary steel cases may be lined with 18-8). Interior parts fabricated from Chrome Alloy Steels to prevent erosion and corrosion.

APPLICATION ★ Pacific's Engineers are available to assist you in selecting from the PACIFIC TRIO the right pump for your service.

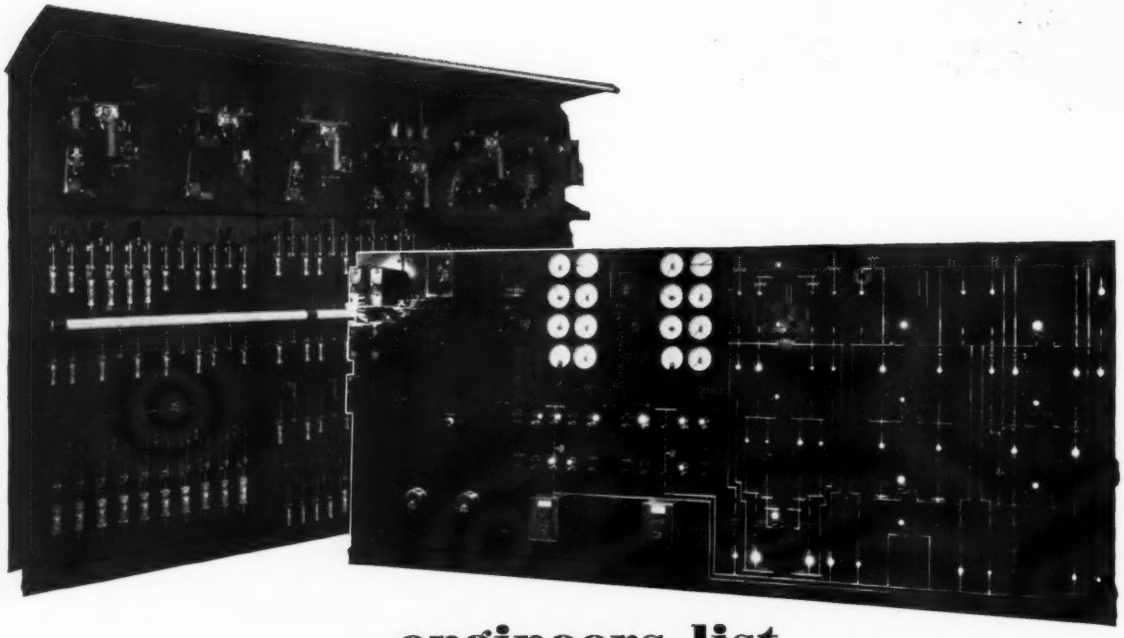
PACIFIC PUMPS INC.
HUNTINGTON PARK, CALIFORNIA

One of the Dresser Industries

PACIFIC *Precision Built* PUMPS

BF-1

Offices in All Principal Cities—Export Office: 122 E. 42nd Street, New York City



engineers list these 6 advantages of K&M EBONIZED ASBESTOS ELECTRICAL MOUNTING MATERIAL

For a safe, dependable apparatus paneling, more and more engineers are specifying K&M Ebonized Asbestos dielectric mounting material. These engineers say Ebonized Asbestos has these 6 advantages:

1. Unusually strong—both dielectrically and mechanically.
2. Highly resistant to shock, vibration, temperature changes.
3. Easy to machine, cut, drill, and handle.
4. Uniform consistency—no veins to cause chipping or cracking.
5. Versatile in use—supplied in various sizes up to 4″ thick.
6. Neat, efficient appearance in finished units.

Ebonized Asbestos is a tough, dense sheet moulded of asbestos fibers, Portland Cement and an insulating compound. It is readily adaptable to such uses as switchboards, bus bar runs, compartment linings, testing tables, bench boards. When built into assembled units, it meets the technical requirements of Underwriters' Laboratories, Inc. Write us for further details—we'll answer your inquiry promptly.

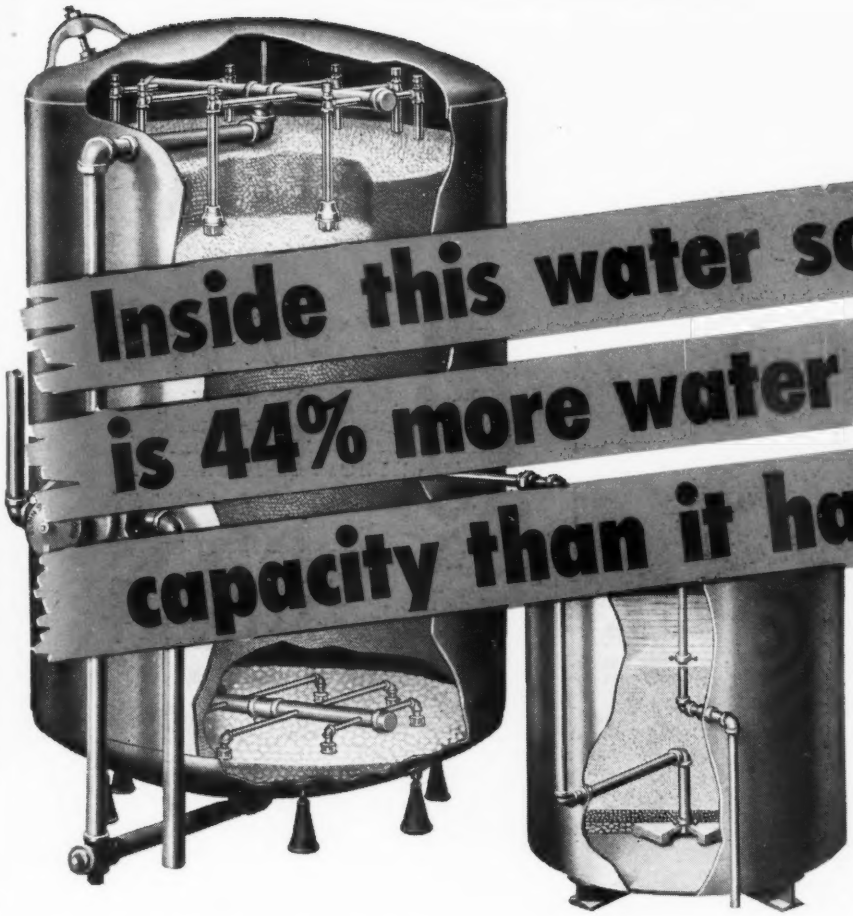
Nature made Asbestos...

Keasbey & Mattison Company has made it serve mankind since 1873

KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

IN CANADA—ATLAS ASBESTOS CO., LTD., MONTREAL, TORONTO, WINNIPEG AND VANCOUVER

DIAMOND ANNIVERSARY 1873 1948 K&M Keasbey in asbestos KEASBEY & MATTISON CO.



Inside this water softener is 44% more water softening capacity than it had before

This is the inside story on how the capacity of a water softener was boosted 44%. Here was a 48" x 72" synthetic zeolite unit, operating on 10-grain water. Its capacity was 48,000 gallons. We equipped it with our ingenious "Double-Check" manifold system which permits a deeper bed of zeolite to be utilized efficiently. (Elgin's "Double-Check" manifold system can be installed in water softeners of any make.) Capacity was thereby increased to 69,000 gallons — representing a gain of 21,000 gallons, or 44% more water softening capacity than before.

This typical case illustrates the remarkable principle on which Elgin Zeolite Water Softeners are based. The "Double-Check" principle not only permits far more zeolite to be placed in a softener unit, but prevents the zeolite from being lost. It also permits a faster backwash rate which keeps the zeolite thoroughly clean and at peak performance. The result is up to 44% more softening capacity than is given by a conventional softener of equal size — more water softened by each cubic foot of zeolite — and less regenerating salt required.

We are happy to give present water softener users these Elgin advantages which cannot be secured from other manufacturers. But we are happier when we can make the installation all Elgin—with the advanced design that is characteristic of our entire line. Those we serve also gain much from Elgin's engineering of the job—an individualized service that draws on our 40 years' specialized experience in all phases of water conditioning.

Whatever your water conditioning problem, won't you give us the opportunity of showing you what the Elgin organization can do for you? The coupon below has been inserted for your convenience. It will bring prompt action from us without obligation to you.

Other Elgin Water Conditioning Products

1. Boiler feed water treatments
2. Corrosion prevention treatments for steam system
3. Corrosion prevention for hot and cold water lines
4. Deconcentrator systems
5. Filters and purifiers
6. Iron removal equipment
7. Aerators and Degasitors
8. Chemical feeders
9. Water testing equipment
10. Elgin Quality Zeolites—all types

Use coupon below for detailed information

ELGIN SOFTENER CORPORATION, 130 N. Grove Ave., Elgin, Illinois

ELGIN
ECONOMICAL
WATER CONDITIONING

Coupon brings facts

I am interested in:

☐ Elgin Water Softener. ☐ Modernizing our water softener.

Product No..... (See numbers above).

NAME_____

COMPANY_____

ADDRESS_____

Mail to—ELGIN SOFTENER CORPORATION 130 North Grove Avenue, Elgin, Illinois

Hose that can take all they can give

It's Hewitt Water Hose . . . engineered for high pressure service and general work

Every construction and maintenance engineer knows the importance of having an extra-tough water hose to depend on for all types of work.

That's why more and more engineers insist on Hewitt Water Hose. They know that it is built right . . . engineered to stand up under the highest pressure construction duties as well as in general use. They know that it lasts longer.

Carcass, cover and tube combine to make Hewitt Water Hose unusually strong, yet flexible enough for easy handling.

The *carcass* is built with plies of tough square-woven duck bonded by highest quality rubber friction. You get *extra strength* under extremely high pressures!

The *cover* is made of special rubber compound that is highly abrasion-resistant. You get *extra durability!*

The *tube* is made of durable rubber compounds. You get *extra long life!*

Plan now to contact your nearest Hewitt distributor. You will find his name listed in the classified pages of your local telephone directory. Or write direct to Hewitt Rubber Division, 240 Kensington Avenue, Buffalo 5, New York.

HEWITT

WATER HOSE

HEWITT RUBBER DIVISION

INDUSTRIAL HOSE • BELTING • PACKING

MORE REASONS WHY HEWITT WATER HOSE MEETS YOUR NEEDS

1

Ends of Monarch hose are protected by thick gum rubber caps to prevent penetration of moisture into the plies.

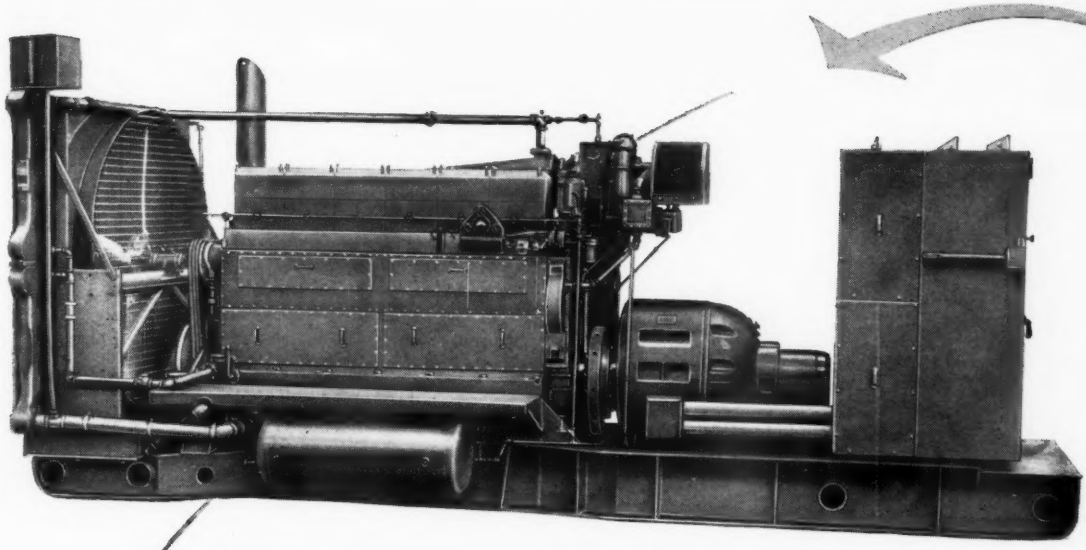
2

Thick, tough, and abrasion-resistant cover is built to withstand dragging over rough terrain and other external abuse.

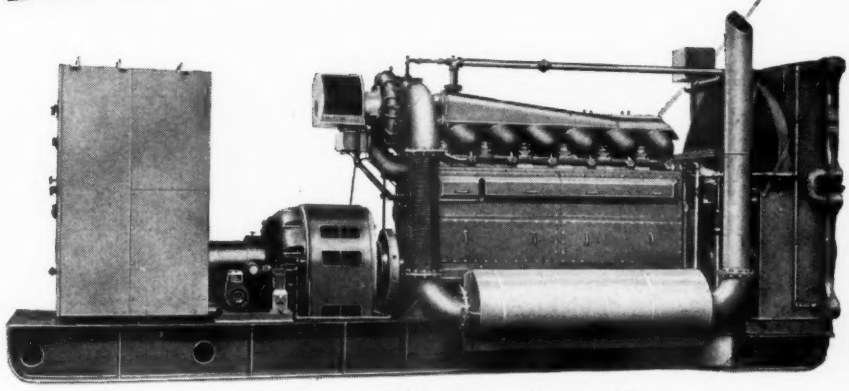
3

Hose tube and cover especially built to withstand acids and alkaline solutions.

HEWITT-ROBINS HR **INCORPORATED**



NEWEST of the CP Diesel-Electric Package Units



REAR VIEW OF 500 KW UNIT

EFFICIENCY PLUS ECONOMY

LOW FUEL CONSUMPTION results from efficient design of combustion chamber, valve mechanism and fuel injection system.

INSTANTANEOUS STARTING is assured by simple starting valve which admits air through distributor. The distributor, in turn, admits air at timed intervals to each cylinder.

DUST-TIGHT COVERS completely enclose all wearing parts, but are easily removed for inspection.

LUBRICATION is completeley automatic force feed, resulting in exceptionally low maintenance.

EVERY PART is designed with ample strength for maximum rigidity with minimum weight, assuring long service life.

An outstanding product of Chicago Pneumatic's 34 years' experience in engine building, this 500 kw CP Turbo-charged Diesel Engine Generator Set* is designed for continuous, medium-speed, heavy-duty service.

Furnished complete with piping, wiring, and all accessories, ready for immediate installation . . . it can be set up quickly and easily...in minimum space...with minimum installation expense.

Write for complete information.

*BUILT UNDER ELLIOTT-BUCHI LICENSE

CHICAGO PNEUMATIC TOOL COMPANY

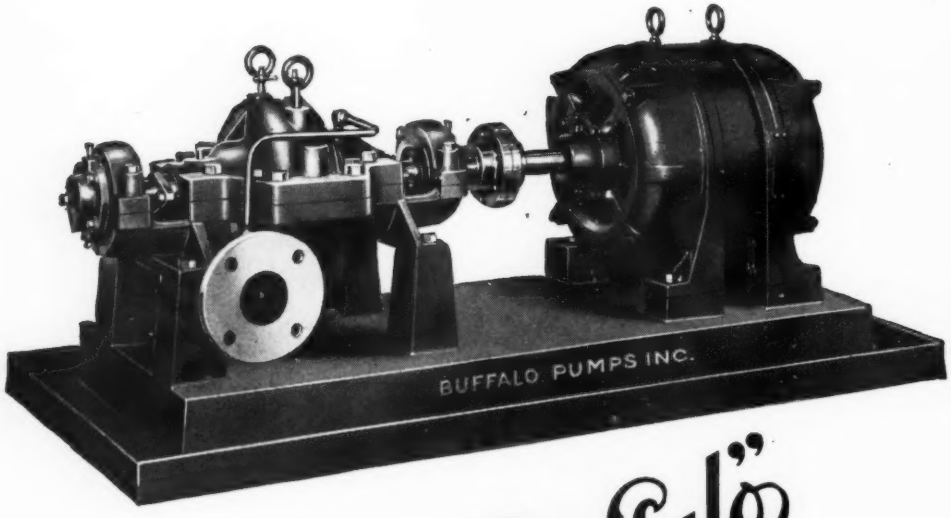
General Offices: 8 East 44th Street, New York 17, N. Y.

AIR COMPRESSORS • ELECTRIC TOOLS • PNEUMATIC TOOLS • DIESEL ENGINES
ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

CENTRIFUGAL PUMPS FOR EVERY LIQUID

"Now you can stop worrying about pump maintenance!"

PUMPS by "Buffalo"



It's a "Buffalo"

CLASS "RR" PUMP

Users of these rugged general service pumps are pretty well agreed that you can "put 'em in and forget 'em". We invite you to look into the oversize construction—the extra large bearings, shafts and impellers—the extra deep stuffing boxes of Buffalo "RR" Pumps. Here are pumps that save you money both through efficiency and durability. *Write for Bulletin 980-B,* if you have a clear water pumping job.

- FOR CLEAR LIQUIDS, ANY TEMPERATURE
- IDEAL FOR BOILER FEED
- EFFICIENCIES UP TO 75%

For

★ WATER ANY TEMPERATURE

★ PAPER STOCKS (NON-CLOGGING)

★ GENERAL SERVICE

★ ACIDS

★ ALKALIS

★ SLURRY

★ CONDENSATE RETURN

★ SUMP CLEARANCE

★ FIRE SERVICE

★ SEWAGE

★ SELF-PRIMING SERVICE

BUFFALO PUMPS, INC.

488 BROADWAY BUFFALO, NEW YORK

Canada Pumps Ltd., Kitchener, Ont.

RUGGED, PRECISION CONSTRUCTION—FOR LONG LIFE

Section of a furnace wall, with damaged brick removed, ready for repair.

Building the patch with Harbison-Walker Plastic Fire Brick. Slabs are ready-cut to convenient size and shape for pounding into place.

HARBISON-WALKER

Standard and Super

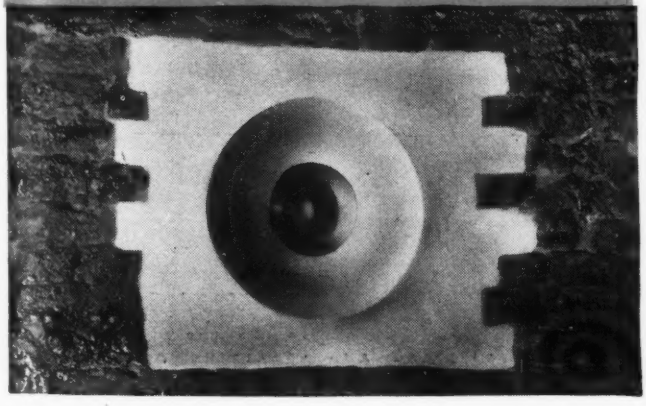
PLASTIC FIRE BRICK

for repairs, burner ports, irregular shapes, arches, linings

A uniform, moldable mixture of high grade refractory materials, H-W Plastic Fire Brick provides an easy, practical means of repairing furnace walls, and of making burner blocks, arches, door linings and special shapes. Monolithic linings also can be readily made of H-W Plastic Fire Brick, with ordinary tools and without special experience. Comes in 3-inch slabs, ready to use, Standard and Super grades.

Write for descriptive bulletin giving complete details and method of installing.

Typical burner block made with H-W Plastic Fire Brick. Used also for arches, doors, and special shapes.



Harbison-Walker Refractories Company

AND SUBSIDIARIES
OFFICES IN PRINCIPAL CITIES

WORLD'S LARGEST PRODUCERS OF REFRACTORIES

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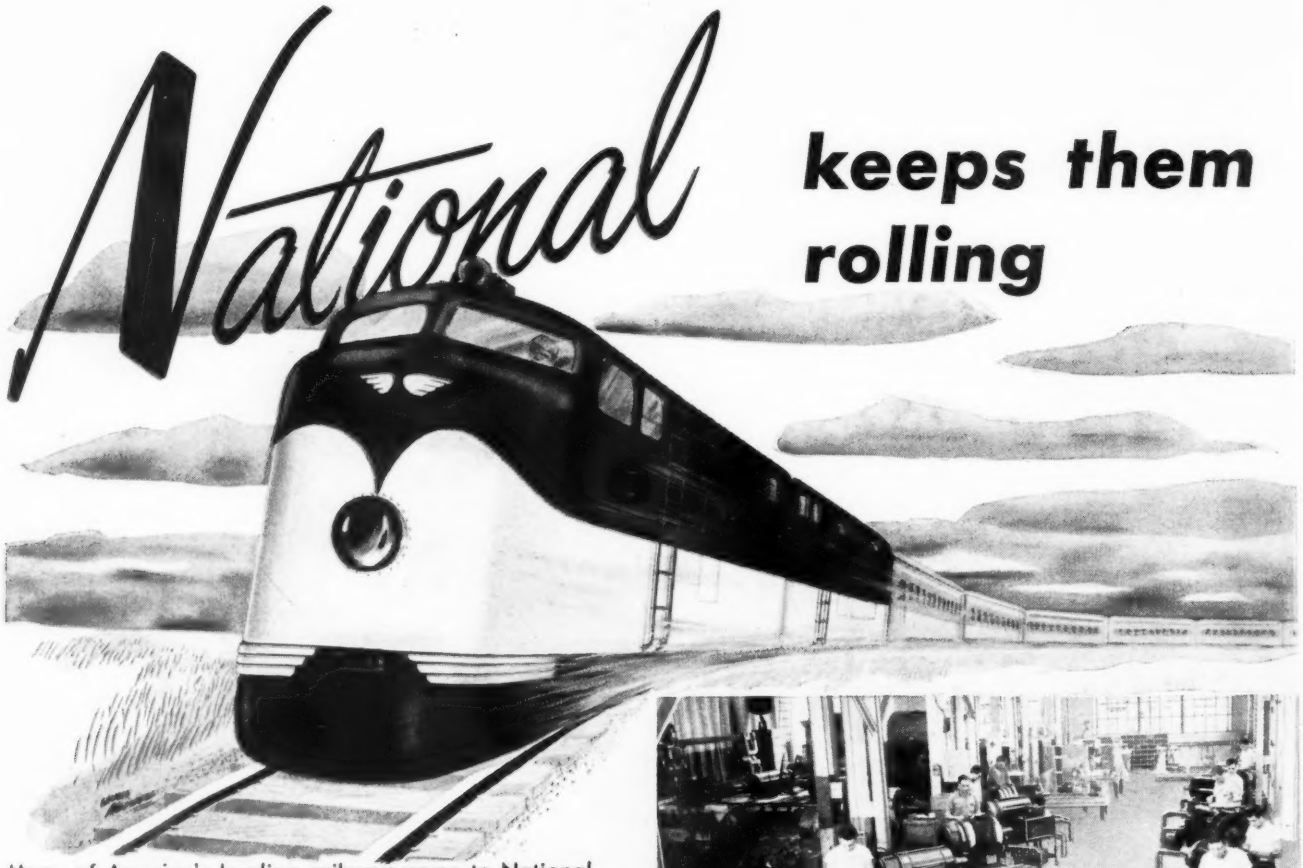
PITTSBURGH 22, PA.

TRADE MARK
REG. U.S. PAT OFF.

National keeps them rolling



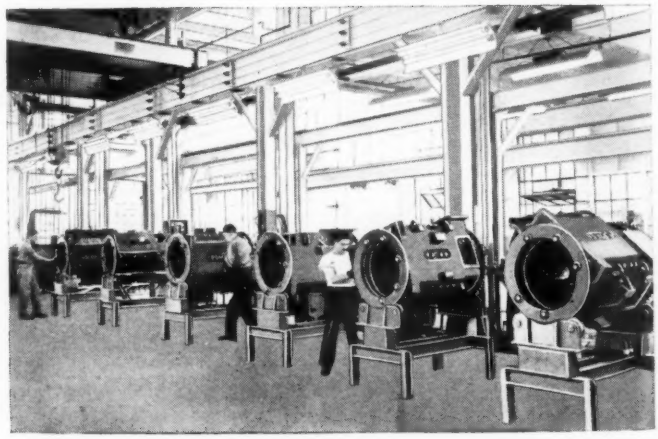
Many of America's leading railways come to National for mileage overhauls and complete rebuilding and rewinding service on their diesel-electric and electric locomotive motors and generators.

That's why they are leaders. They *can't risk* sudden failures on the road. They *can't afford* premature failure. They *must have* minimum cost per ton mile.

And that's a prescription which fits the leaders in *any* industry. If you could put your finger on all the losses which pile up in *your* plant when a piece of rotating electrical equipment fails in the midst of production you would do almost anything to avoid it. If you figure the savings possible by spacing overhaul periods 25% farther apart you'll be amazed.

We are not miracle workers, but we keep 'em rolling. We know, by intimate experience, the factors which affect coil life. We can often devise special means to overcome excessive trouble. Better ventilation; changes in wire sizes; different insulation; care in application.

Standard National coils (they're really super-standard) are quickly available for any rotating electrical machine. National pioneered the manufacture and use of Mica-Glas (registered trade-mark) electric insulation, available for application in your shop as listed in our Insulation Catalog. National rebuilding and redesigning (to overcome special weaknesses or to change electrical characteristics) are as near as your near-by National Field Engineer. If you don't know him, let us know. He's there to help you.



Two steps in the rehabilitation of traction motors in our plant

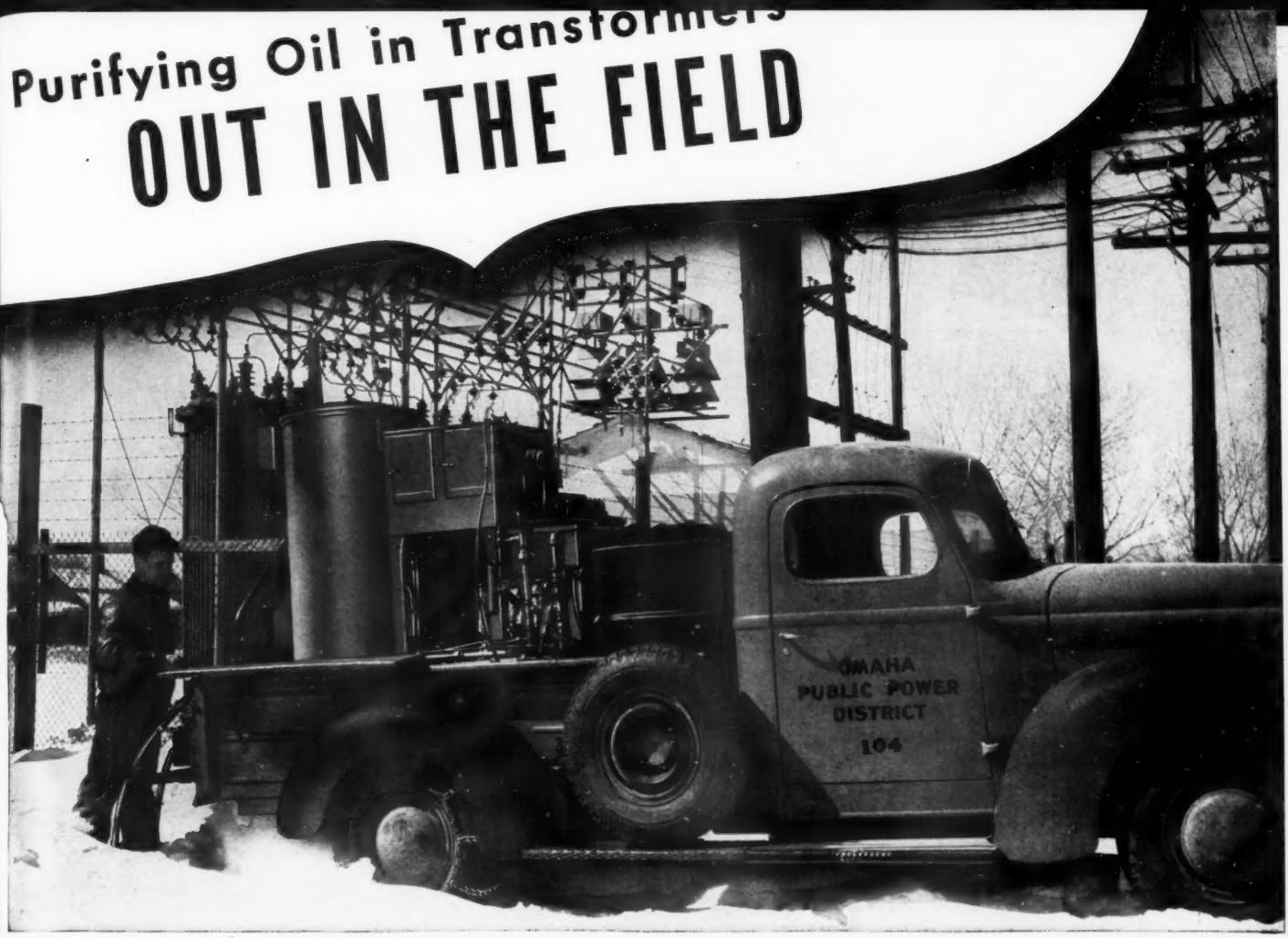
NATIONAL ELECTRIC COIL COMPANY

COLUMBUS 16, OHIO, U. S. A.

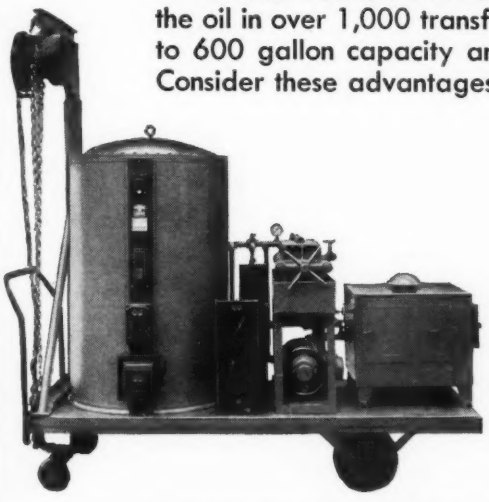
ELECTRICAL ENGINEERS: MAKERS OF ELECTRICAL COILS AND INSULATION— REDESIGNING AND REPAIRING OF ROTATING ELECTRICAL MACHINES

TRADE MARK

Purifying Oil in Transformers
OUT IN THE FIELD



Honan-Crane "R" Type Purifier mounted on pickup truck purifying oil in a transformer at substation located at 16th Avenue and 11th Street, Council Bluffs, Iowa. Picture taken on coldest day of year, —16°, March 11, 1948.



● Omaha Public Power District uses a HONAN-CRANE "R" TYPE OIL PURIFIER to maintain the oil in over 1,000 transformers in their 300 substations. These transformers are mostly 300 to 600 gallon capacity and some of them are located 55 miles from the shop in Omaha. Consider these advantages:

1. Purifier is brought to transformer and oil is purified without shutting off transformer.
2. Circulation of purified oil through the transformer cleans up any deposits that may have formed on the coils or case.
3. Proper schedule of purification keeps oil free from a buildup of contamination and guards against oil and transformer failure.
4. This purifier has been in operation since 1944 and no oil has been discarded since the purifier has been in use.

A second Honan-Crane "R" Type Purifier was purchased by Omaha Public Power District in 1946 and is used at the power plant to purify oil in several large banks of transformers outside the plant, about 200 small units inside the plant including voltage regulators, switches, reactors, etc., and the turbine oils used in the steam turbines.

A HONAN-CRANE PURIFIER IS THE MOST EFFECTIVE AND ECONOMICAL MEANS OF MAINTAINING EITHER INSULATING OR TURBINE OILS FREE FROM CONTAMINATION

PLEASE SEND COMPLETE INFORMATION ON

- ☐ Honan-Crane "R" Type Purifier for Insulating Oils
- ☐ Honan-Crane Purifier for Turbine Oils
- ☐ Engineering Bulletin on Purifying Insulating Oils
- ☐ Engineering Bulletin on Purifying Turbine Oils
- ☐ Please have a Honan-Crane Sales Engineer call.

NAME_____

COMPANY_____

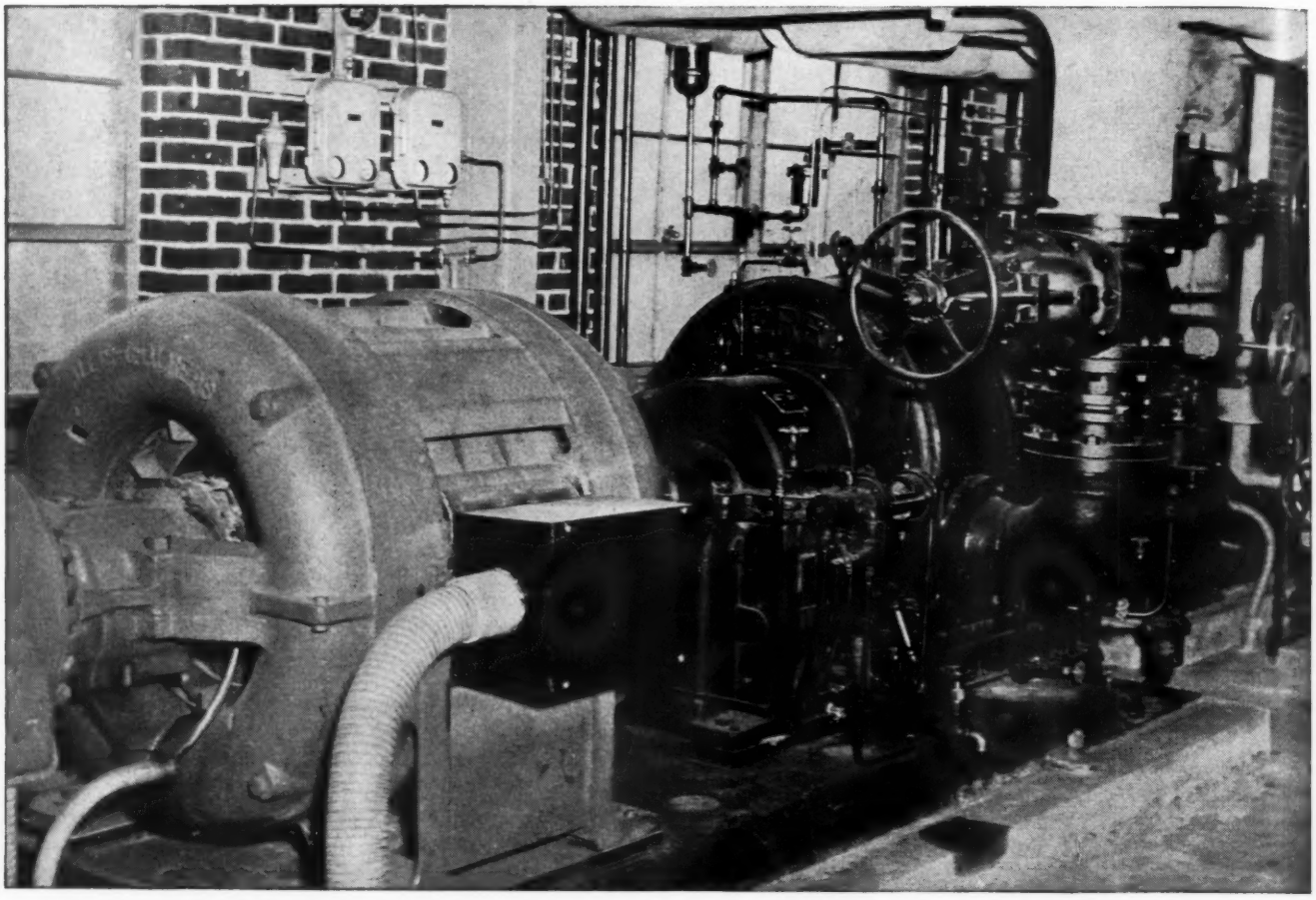
ADDRESS_____

CITY_____ STATE_____

HONAN-CRANE CORP.
1200 SIXTH STREET, LEBANON, INDIANA

A SUBSIDIARY OF
HOUDAILLE-HERSHEY
CORPORATION

The TERRY TURBINE



For By-Product Power and Steam Balance

This 200 kw Terry Turbine driven generating unit operates in parallel with other generating equipment, the load on the unit being adjusted in accordance with the demands for exhaust steam. It is a single stage axial-flow, type, 4500/1200 rpm, 160 psi, 0 superheat, 5 psi back pressure, equipped with Terry reduction gears, oil-relay governor, motor synchronizer and back-pressure regulator.

The installation pictured above is typical of many special applications of Terry Steam Turbines, each designed for specific requirements.

Any of our district representatives will gladly give you full information on a turbine to meet your requirements, no matter how special they may be.

No obligation, of course.

T-1178

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

Engineers agree, **"they go in faster and stay in longer"**

NATIONAL SEAMLESS
BOILER TUBES

THE record of outstanding reliability that these famous "Walls Without Welds" have established during more than half a century of power plant service is due primarily to one thing—the unique piercing process by which U·S·S NATIONAL Seamless Boiler Tubes are made.

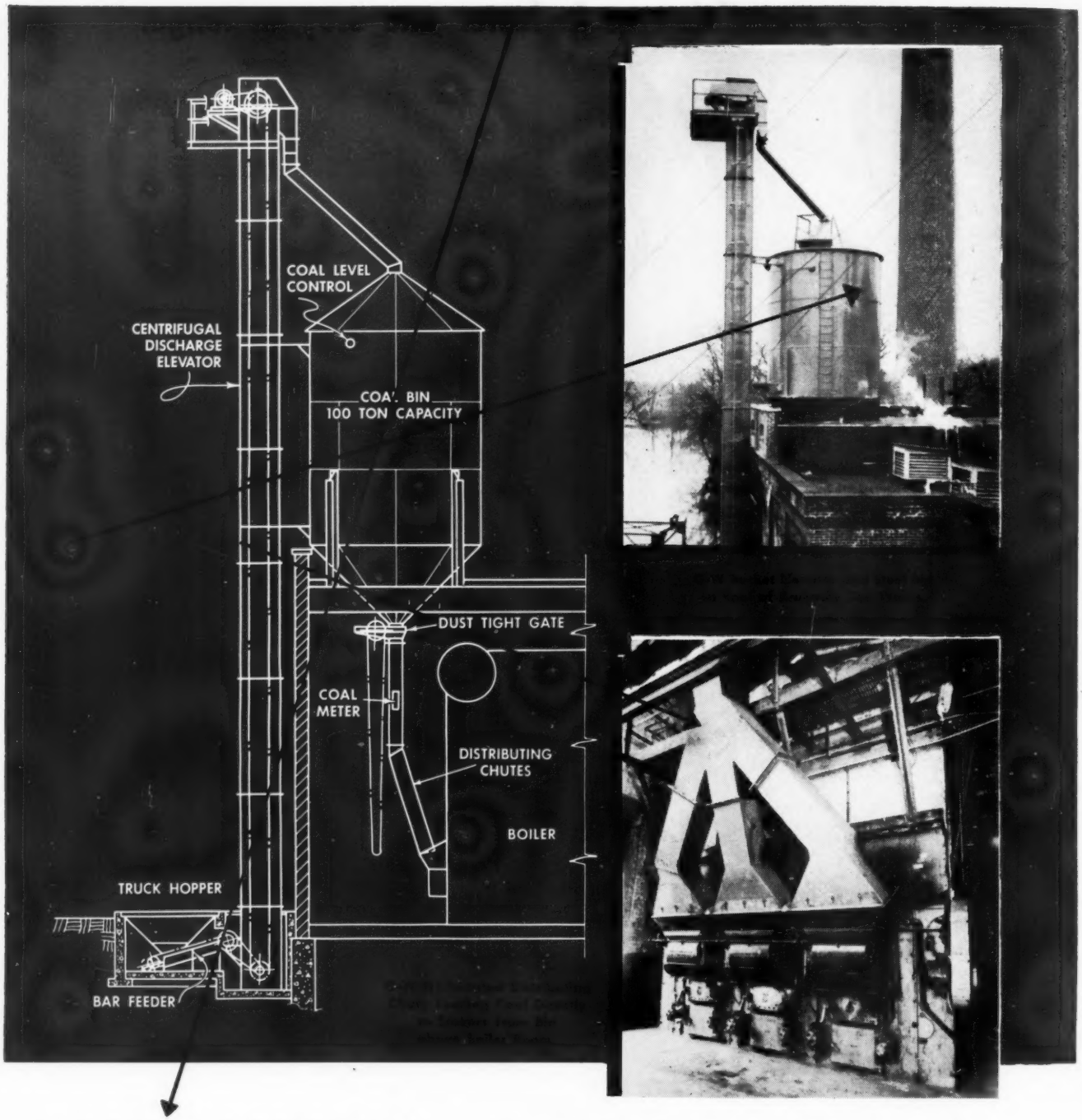
Making boiler tubes by piercing a solid billet of steel is a drastic test of steel quality. No other method offers such positive assurance of uniform wall strength. One continuous piece of steel from end to end, NATIONAL Seamless Tubes assure the safety, security, and dependability of a solid steel forging. There is no weld of any kind to provide a starting point for failure—the wall strength is uniform throughout.

Their better heat transfer characteristics, their higher creep strength at elevated temperatures, and their easier, faster installation result from the fact that NATIONAL Seamless Tubes are made from completely "killed" (thoroughly oxidized) steel and that every tube has been 100% annealed.

NATIONAL TUBE COMPANY
PITTSBURGH, PA.
Tubing Specialties Division
Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Export Company, New York

WALLS WITHOUT WELDS

UNITED STATES STEEL



IN THIS CASE tight quarters saved dollars

When Braendly Dye Works, Inc., at Beacon, N. Y., modernized their steam boiler plant, a mechanical coal-handling system was required to replace the old, slow manual method. A G-W engineer was called in . . . recommended the elevator-storage system illustrated.

A river bank restricted ground storage space . . . a disadvantage that G-W ingenuity converted into economies. A live storage, steel bin was designed and mounted on roof directly over boiler room. Coal is supplied to bin by a bucket elevator and fed continuously by gravity directly to stokers. Warm boiler room air surrounds bottom cone of bin . . . prevents coal freezing.

Elevator boot is fed by bar type feeder which permits a truck hopper shallow enough to safeguard against flooding when river is high.

G-W took over *this* complete job . . . from design through construction and erection . . . shouldered all responsibilities. G-W's complete engineering service is yours for the asking.

G-W HANDLES IT . . .
faster • easier • cheaper

SINCE 1814

GIFFORD-WOOD CO.

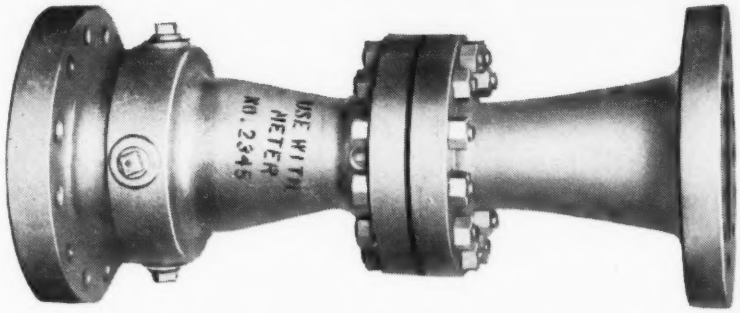
4208

NEW YORK 17
420 LEXINGTON AVENUE

Factory:
Hudson, N. Y.

CHICAGO 6
565 W. WASHINGTON ST.

VENTURI TUBE



FOR THE GREATEST ACCURACY IN FLOW MEASUREMENT!

TYPE MO METER

The correct design and careful workmanship of Simplex Venturi Tubes insure stable coefficients over wide velocity ranges, enabling the accompanying meter to measure flow with extreme accuracy. The high efficiency in the utilization of the differential pressure head is the result of more than 40 years of manufacture and research by this company.

Simplex Type MO Meters, when used in conjunction with Simplex Venturi Tubes as primary devices, guarantee the utmost accuracy in flow measurement over long ranges. They can be furnished to measure accurately over ranges of 20 to 1, 25 to 1, 28.5 to 1 or 32.5 to 1.

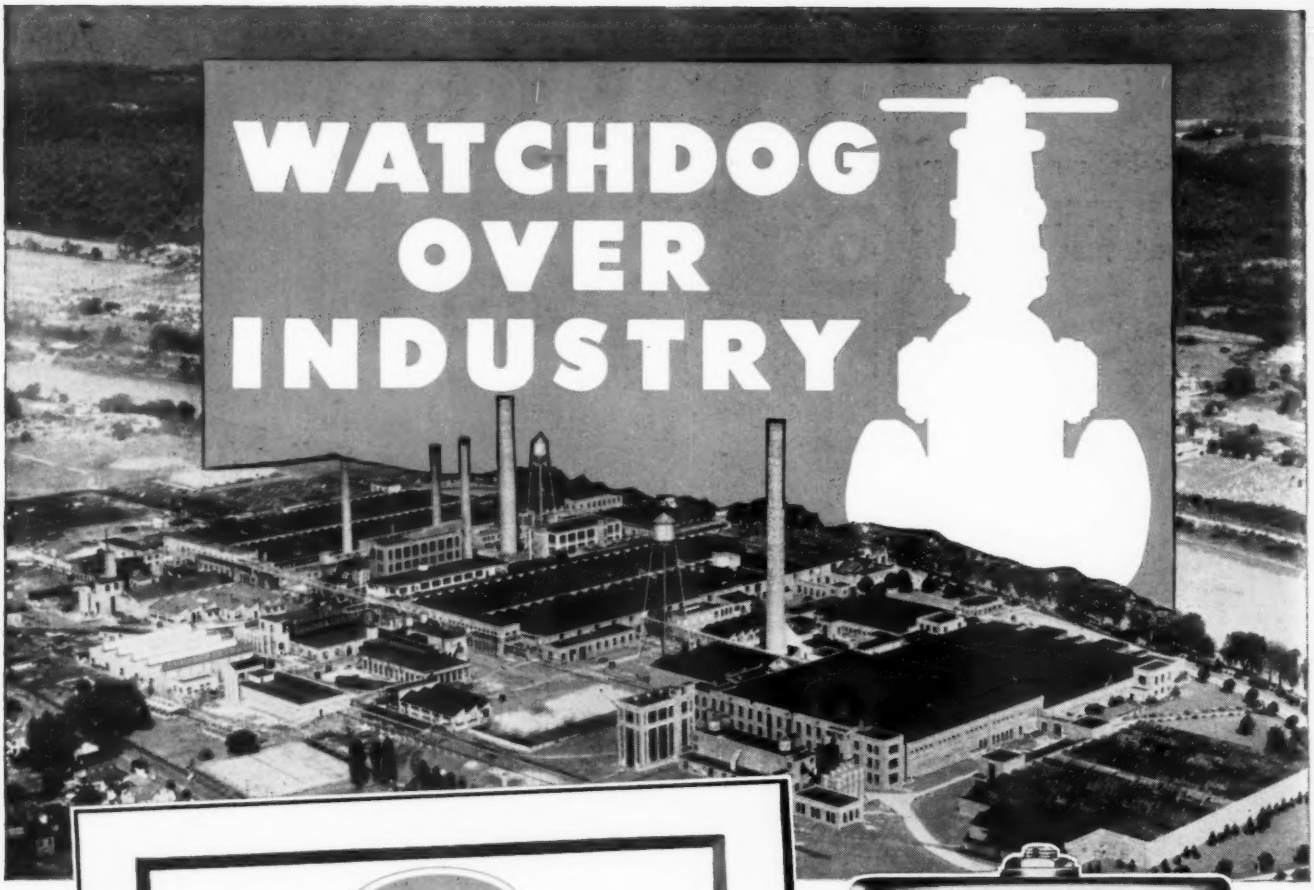
Where flow ranges are long, a single meter often will be sufficient where two or more ordinary instruments would otherwise be required.

For full information and bulletins write to the Simplex Valve & Meter Company, 6780 Upland Street, Philadelphia 42, Pa.

SIMPLEX

VALVE AND METER COMPANY

WATCHDOG OVER INDUSTRY

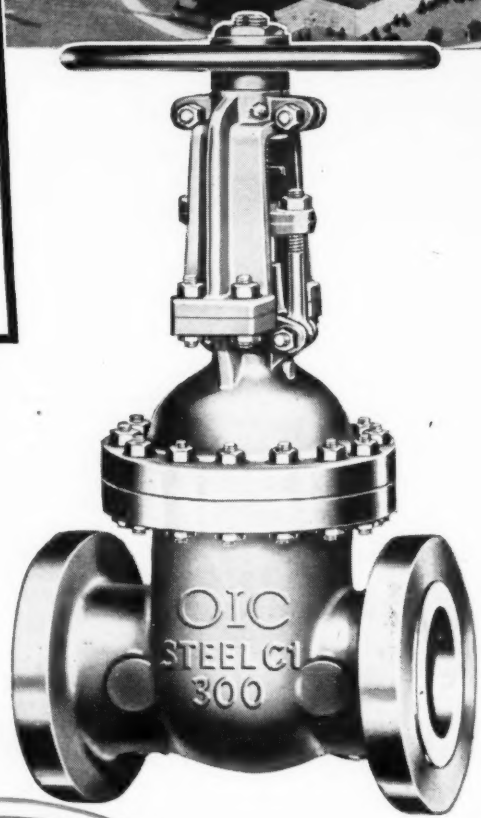


OIC

PACE-SETTER IN VALVES

Everywhere OIC Valves are the trusted guards of industry's vast resources! By day and by night they constantly watch over millions of dollars in industrial materials. Leak-proof joints guard against disastrous pressure-drop. Streamlined designs protect flow from turbulence. Heavier construction throughout keeps pressures and stresses within safe bounds. Wedges of heavy I-beam design keep a close watch on the fluid passageway, stopping all flow with positive, leak-proof closure, or opening the streamlined ports for smooth, even, *free* flow! Integral body ribs guide the wedge to its seats with unerring accuracy—effectively reduce vibration and wear.

Your pipelines are *safer* when they're protected by OIC, Pace-Setter in Valves!



VALVE INFORMATION THAT YOU NEED IS ALWAYS AT YOUR FINGERTIPS IN THE BIG 248-PAGE CATALOG! . . .
Send for your free copy today. You'll save time with the valve data and specifications that you can use so quickly and easily. Simply write The Ohio Injector Company, Wadsworth, Ohio.

OIC VALVES

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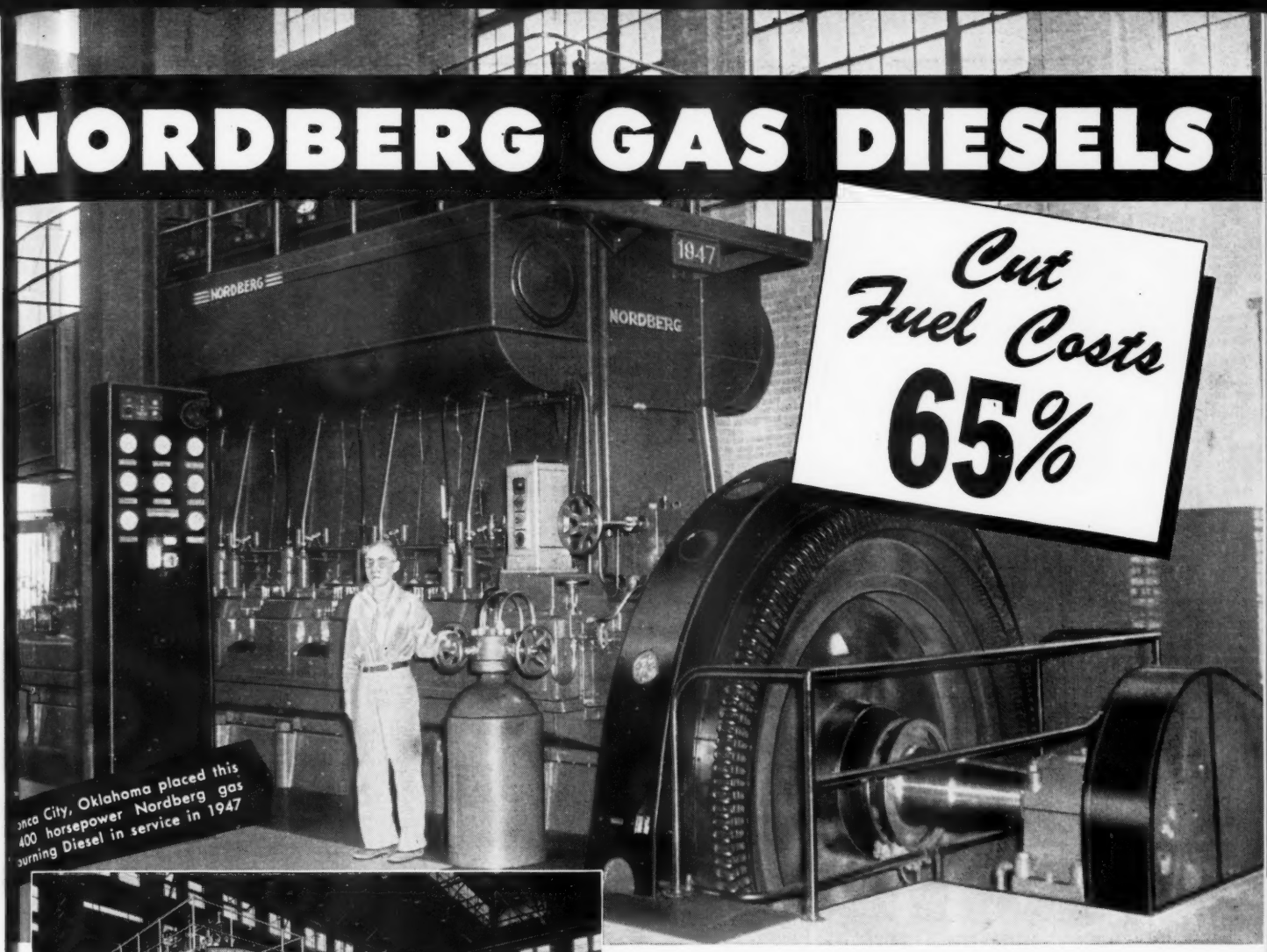
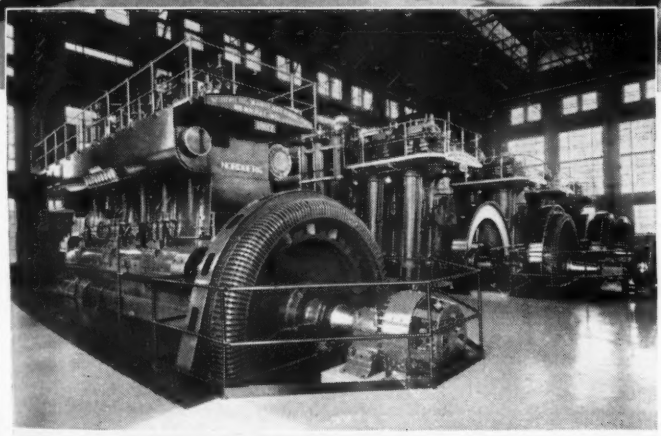
STEEL • IRON • BRONZE

NORDBERG GAS DIESELS



Cut Fuel Costs 65%

onca City, Oklahoma placed this 400 horsepower Nordberg gas burning Diesel in service in 1947



In this plant there are also four 1250 horsepower oil burning Nordberg Diesels installed between 1923 and 1928 and a 2400 horsepower installed in 1937 but now converted to gas, making a total installed horsepower of 9800.

• The municipal power plant at Ponca City, Oklahoma during its twenty-five years of service to the community has always been outstanding as a producer of low cost power. Plant Superintendent Pat Schlesinger reports a saving of 65 percent in fuel costs of the new gas burning Nordberg Diesels as compared to the oil burning engines. For dependable low cost power, investigate the merits of Nordberg Diesel power.

NORDBERG MFG., CO.
MILWAUKEE 7, WISCONSIN

BUSCH-SULZER DIVISION OF NORDBERG

NORDBERG DIESEL ENGINES

NORDBERG MACHINERY

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" BRASS CO. *Headquarters for BRASS, BRONZE, and COPPER*

Heavier Gauges for Longer Tube Life

With power plant equipment in many instances running at maximum capacity and on practically a continuous basis, and with corrosion problems on the increase, power plant engineers are subjecting methods and materials to searching analyses, with an eye to operating at highest efficiency and to keeping maintenance to a minimum.

They are concerning themselves more and more with the subject of condenser tubing—studying those which have failed in service, keeping detailed records and working closely with condenser tube manufacturers. Most important of all, there is a definite trend toward the use of more corrosion-resistant condenser tube alloys, on the basis that the highest quality is most economical in the long run.

Heavier Gauges Considered

In connection with this thinking in terms of better materials and higher quality for increased life, some power plant engineers are giving serious consideration to the use of heavier gauge condenser tubing. In some power plant auxiliary equipment, *i.e.* feed water heaters, heavy gauges are required by Code because of increased pressures. Although the majority of specifications call for condenser tubing with wall thickness of .049″, there is no valid reason why that gauge is the most desirable. As a matter of fact, there are several reasons why heavier-walled condenser tubing should be more beneficial in certain cases.

Advantage of Heavier Gauge in Combating Corrosion

Where corrosion is proceeding at a uniform rate or is slowing down as it attacks the metal, the advantages of greater wall thickness can be readily shown to result in longer life and fewer service interruptions. For example, assuming a simple case of uniform corrosion where the metal is attacked at .004″ per year, a .049″ wall would be reduced to .025″ within six years. Experience has shown in some instances that when the wall thickness reaches approximately .025″, the useful life of the condenser tubing has practically ended. This is due to weakening of the tube, especially in the joint at the tube sheet. When the tube fails to hold tightly, cooling water leaks into the condensate. Any attempt to tighten the weakened tube may result in collapse of the thin wall. Furthermore, in many cases, plug-type dezincification or corrosion pits form in conjunction with the uniform corrosion and penetrate deeply into the remaining .025″ of metal. On the other hand, it is obvious that on the same basis tubing with a wall thickness of .065″ (16BWG) would be more satisfactory and would last about ten years as against six years for .049″ tubing.

In some instances the corrosion ceases or slows up after proceeding to a certain depth. Under such circumstances heavier walled tubing would provide the extra margin of metal which would make the difference between early failure and long service.

Heavier walled tubing makes for more satisfactory installation. It saves time in the long run. Heavier walls also make possible more successful flaring operations. With the proper tools no difference should be noticeable in the time required for rolling or packing the tubes, but tighter, more dependable joints should result. The greater rigidity of heavier walled tubing makes it easier to thread the tube through the tube supports, and it is noticeably less subject to distortion due to improper handling or long storage.

Because of the greater resistance of heavier walled tubing to distortion, relatively high stresses are not so readily set up. This means that under conditions of rough handling there is less chance of setting up stresses, which could ultimately lead to season cracking in some corrosive environments involving ammonia. This has been confirmed by laboratory tests on Admiralty ¾″ O.D. x .049″ wall vs. ¾″ O.D. x .065″ wall. It should be remembered, of course, that increased wall thickness in itself does not guarantee immunity to season cracking.

What Gauge is Best?

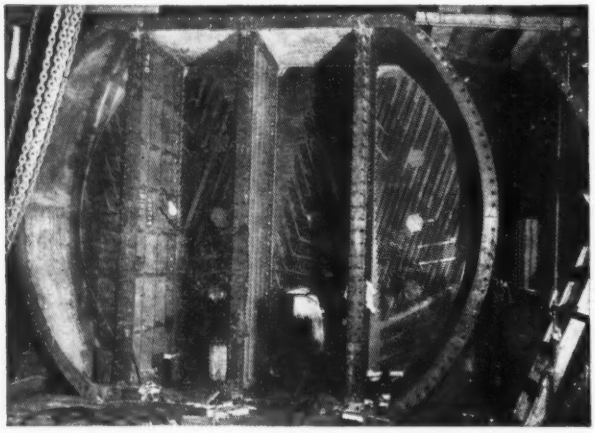
This is a question which cannot be answered without studying all the factors involved. For example, research indicates that with some alloys under certain conditions the rate of corrosion accelerates as the metal is attacked. In such instances, even though a heavier wall will outlast a thinner wall, the economic advantage is not significant. In other words, the heavier wall will not last enough longer to make the added expense worthwhile. However, where the corrosion rate remains constant or slows up with time, the economic advantage of greater wall thickness can readily be proved.

Of course, wall thickness must not be increased to the point where excessive reduction of inside diameter leads to increased water velocity, which in turn increases the possibility of impingement corrosion.

Other factors which must be considered when substantially reducing the inside diameter of condenser tubing are the nature of debris in the cooling water and the mesh size of the rotating screens. Care should be taken to assure that the size of mesh in the screens is smaller than the inside diameter of the tubes, otherwise debris will get past the screens and may cause trouble. Debris lodged in condenser tubing may lead to deposit attack, impingement corrosion by deflection of corrosive cooling water against the tube wall, or both.

Consult Laboratory

It is suggested that power plant engineers consult Bridgeport's Corrosion Laboratory for assistance in selecting the condenser tube alloy most suitable for the conditions involved. The results of many years of experience and the services of trained corrosion personnel are available. Bridgeport will be pleased to have the opportunity of cooperating. Contact the nearest branch office for full information. Write for 120-page Condenser Tube Manual, containing valuable information about corrosion, available condenser tube alloys, suggestions for increasing tube life, methods of installing and specifications.

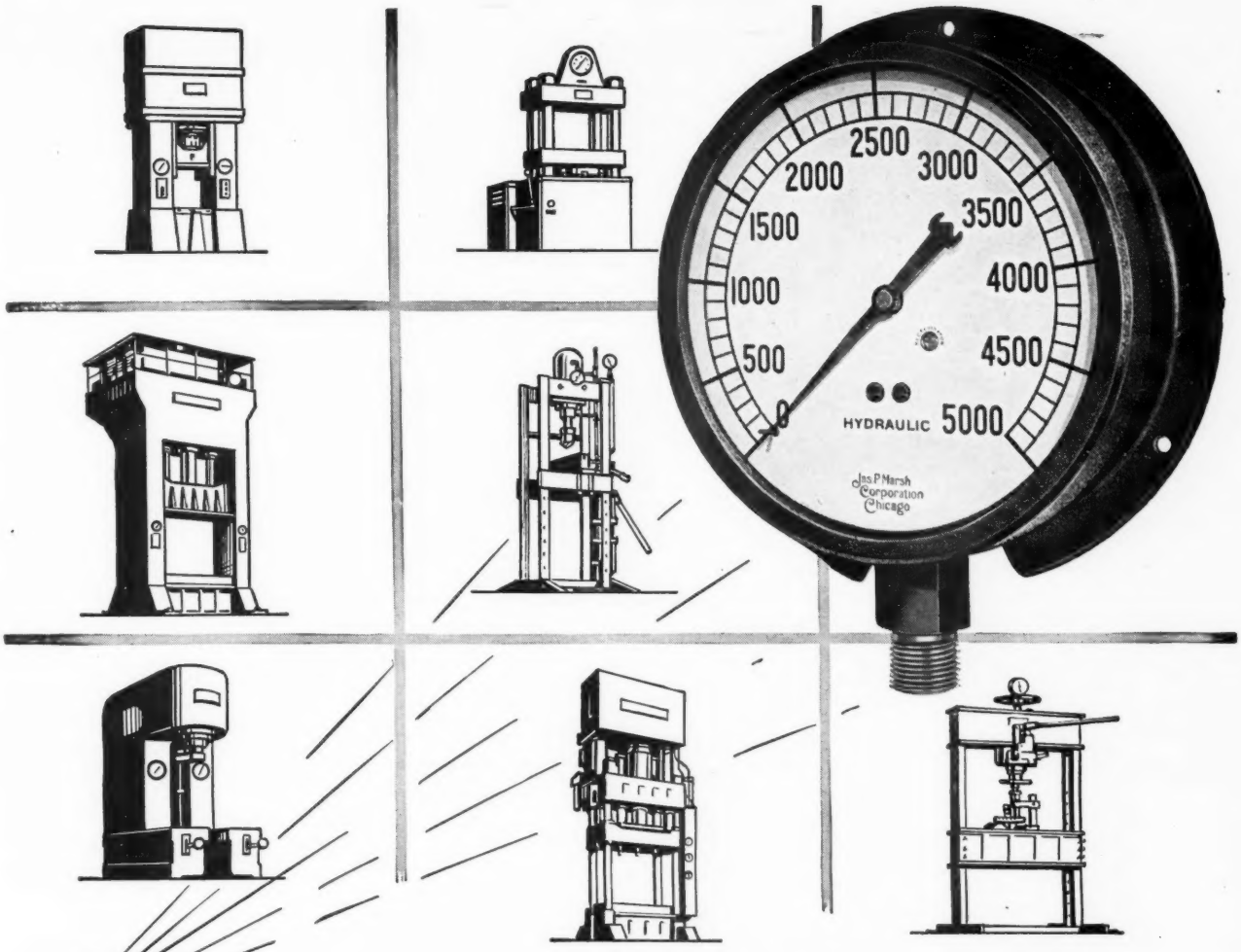


ONE OF THE NEW CONDENSERS built by Worthington Pump & Machinery Co. for Consolidated Edison Co. being installed at their Waterside Station No. 1, New York. With a steam-condensing capacity of 710,000 pounds per hour, this will serve a 60,000 kw turbine unit. 10,945 Aluminum-Bronze tubes are employed in this condenser, which has a flow rate of 52,600 gallons per minute of sea water.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • *ESTABLISHED 1865*

Mills at Bridgeport, Connecticut, and Indianapolis, Indiana • In Canada: Noranda Copper and Brass Limited, Montreal



PREFERRED!

. . . by 59 leading makers of hydraulic machinery

Hydraulic service imposes extra-heavy demands on pressure gauges. Applied to hydraulic machinery, gauges must be extremely accurate, yet sufficiently rugged to stand up under the high pressures and unpredictable shocks which characterize hydraulic operation.

As a result, manufacturers in this field are highly critical in selecting gauges. So there could be no more impressive tribute to Marsh quality and stamina than the preference accorded Marsh Gauges in this particularly difficult field.

Here is a field in which firms are large in size, but small in number; yet Marsh Gauges are currently used by 59 leading manufacturers whose output, conservatively estimated, represents a substantial majority of the nation's production of hydraulic machinery. The products include every type of equipment—testing, lifting, forging, forming, broaching and forcing presses applying pressures up to thousands of tons.

Yes, the designers of hydraulic equipment have recognized in Marsh Gauges the same combination of qualities that they have so well mastered in their own equipment—the combination of accuracy *and* stamina. A significant tribute, this, but merely one more example of the preference accorded Mash Gauges, in *many* fields.*

For *your* pressure gauge needs, why settle for less than the instruments preferred by the most critical users of pressure gauges?

JAS. P. MARSH CORPORATION
Dept. F, Skokie, Illinois
Export Dept.: 155 E. 44th St., New York 17, N. Y.

Jas. P. Marsh products include: A full line and range of gauges in pressure, compound, altitude, hydraulic, sprinkler, ammonia, ounce-graduated retard, test, and diaphragm types. Dial thermometers in rigid stem and remote reading types. A broad line of steam and hot water heating specialties. Ask for literature.

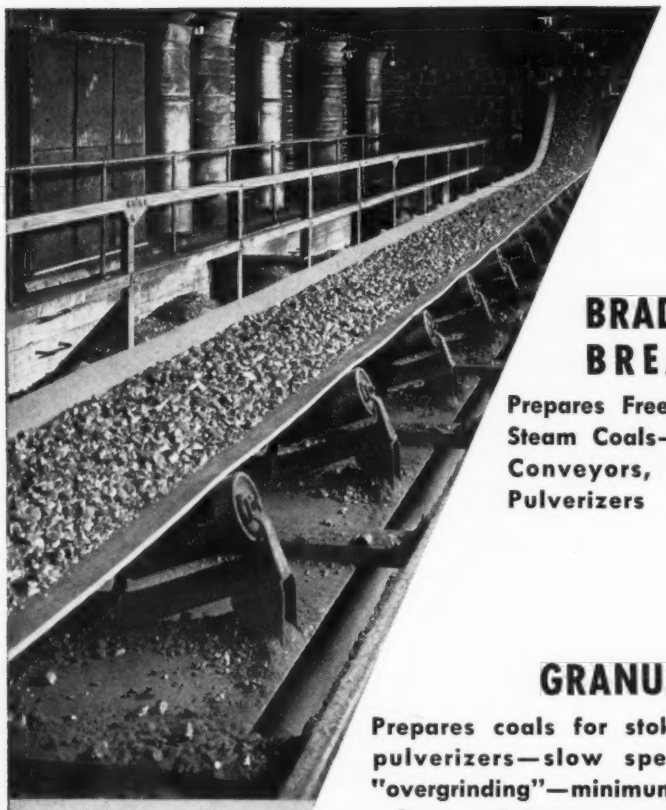
FOR YOU
FOR GIFTS
FOR PREMIUMS

Handsome New Marsh Duo-temp Thermometer shows outdoor and indoor temperatures *inside* your home or office. Reads like a clock. Highly accurate. Write for details.

MARSH GAUGES

"THE STANDARD OF ACCURACY"

*Subsequent advertisements will cite additional examples of this.



Typical "Pennsylvania" Bradford Breaker prepared coal, just as it came from the breaker at a Central Station installation. (Unretouched photograph.) Uniform, no oversize, minimum fines.

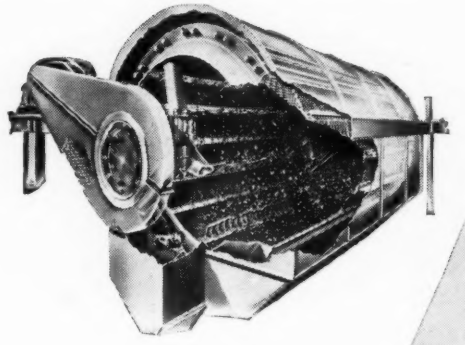
"PENNSYLVANIA" STEELBUILT

CRUSHERS

FOR CENTRAL STATIONS AND INDUSTRIAL POWER PLANTS

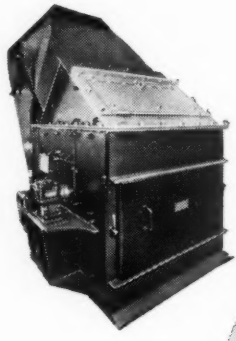
BRADFORD BREAKER

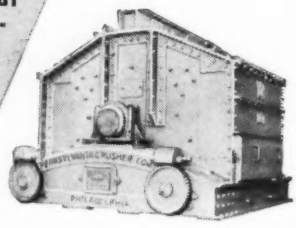
Prepares Free-Flowing Steam Coals—Protects Conveyors, Stokers, Pulverizers



GRANULATOR

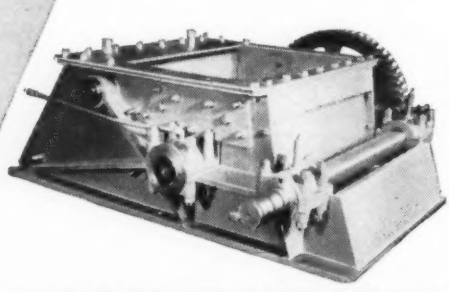
Prepares coals for stokers and pulverizers—slow speed, less "overgrinding"—minimum dusting—low maintenance and power





REVERSIBLE HAMMERMILL

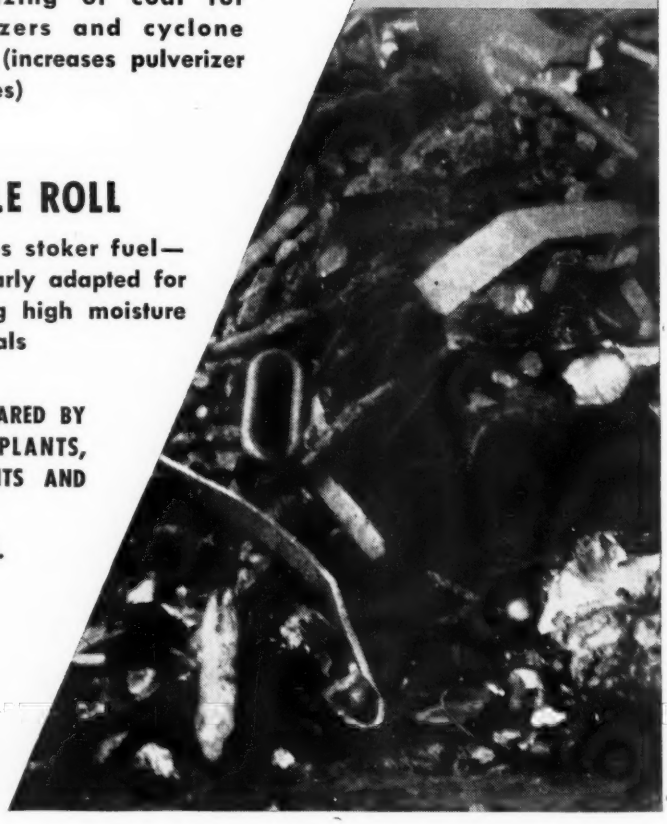
Fine sizing of coal for pulverizers and cyclone burners (increases pulverizer capacities)



SINGLE ROLL

Prepares stoker fuel—particularly adapted for handling high moisture strip coals

Typical pile of tramp iron and other refuse removed automatically from coal during preparation by Bradford Breaker.



OVER 300,000,000 TONS OF COAL PER YEAR ARE PREPARED BY "PENNSYLVANIA" CRUSHERS IN MINES, CLEANING PLANTS, BY-PRODUCT COKE PLANTS, INDUSTRIAL POWER PLANTS AND CENTRAL STATIONS.

LET US HELP YOU WITH YOUR CRUSHING PROBLEMS.

PENNSYLVANIA CRUSHER COMPANY

DIVISION OF BATH IRON WORKS CORPORATION

Liberty Trust Bldg. Philadelphia 7, Pa.

New York • Pittsburgh • Chicago • Los Angeles • Birmingham

Associated with Fraser & Chalmers Engineering Works, London

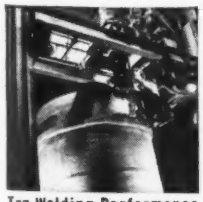
Metallurgical Research conducted continually by recognized specialists who have made major contributions in this field.

Unique Technical Backing of an extensive organization with an international reputation in both process and fabrication engineering.

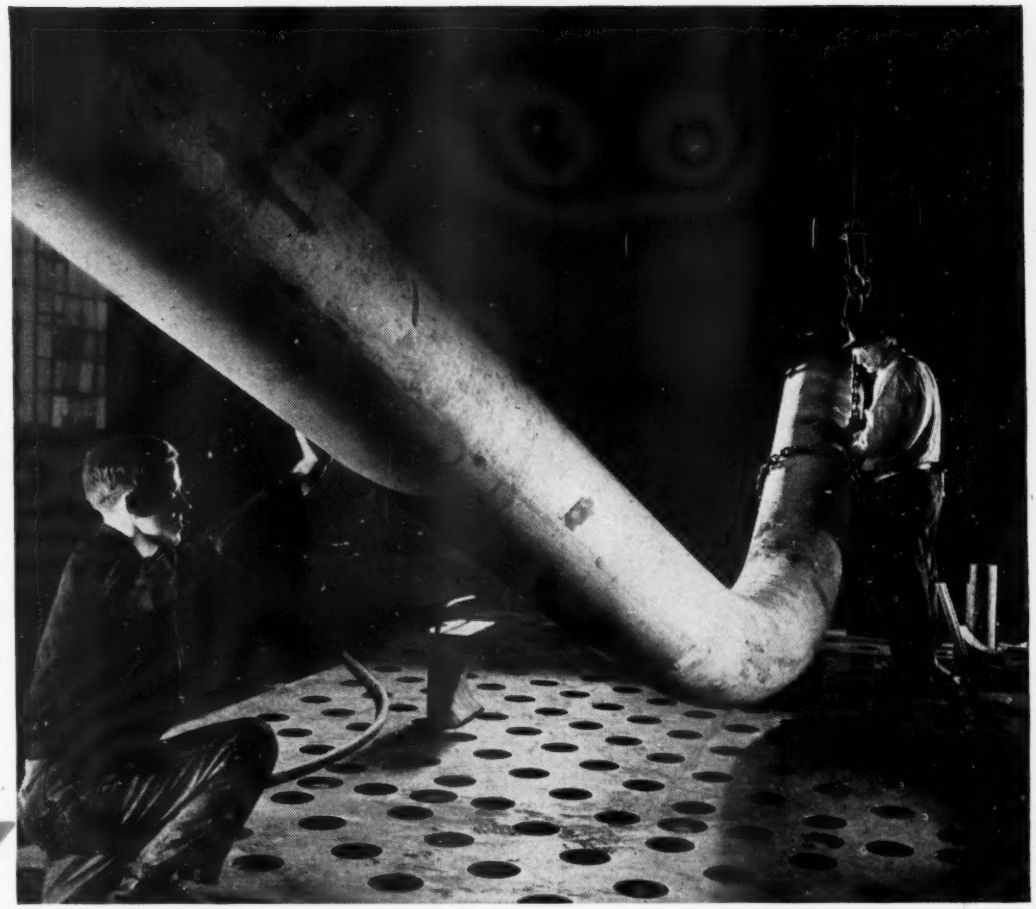
Complete Facilities for the fabrication of steel products from simple forgings to the most intricate 120 foot towers.

Quality Control embracing the constant application of the most advanced inspection methods, both visual and non-destructive.

On-Time Delivery made possible by a flexible planning group authorized to re-route work to meet promised dates.



Top Welding Performance assured by specially designed equipment and exclusive employment of master operators.



When is the best time to judge the quality of power piping?

Here is a pipe bend for a power installation—about to start on its way to you.

For its intended service, steel of the correct analysis has been specified. It has been welded under laboratory supervision and radio-graphed. It has been bent hot, with careful temperature control—*no water quenching!* And finally it's been properly heat-treated. To all intents and purposes, it is the best power-piping that money can buy.

But *is* it? That you can't tell *until it's hooked up to your equipment, ready to play its part in the steam line.*

To make the erection job match shop fabrication in quality, controls must be extended to the *job site.* Because here, stresses *set up during field welding* can produce metallurgical faults *which can affect seriously the life of both piping and connected equipment.*

For instance, knowing exactly where to apply support to piping—and how much to apply—during field welding and heat treating is one of the important control factors.

To assure that this and many other necessary precautions are taken during erection of power piping, we here at Kellogg have *integrated* our field installation service with both our shop and metallurgical laboratory staffs—providing both experienced erection technicians and the latest metallurgical know-how at the most important spot: *the job site.*

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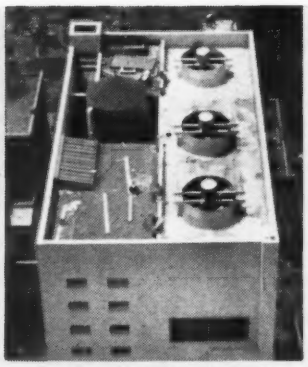
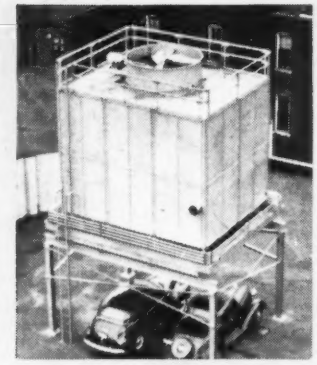


NEW YORK *



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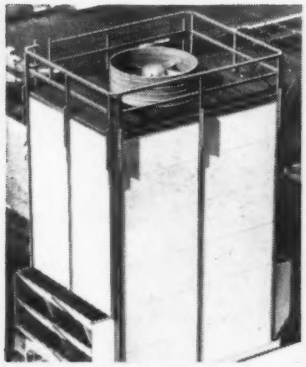

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Operate Economically and Efficiently

Across the nation, Pritchard has solved the water cooling problems of many air conditioning and refrigeration installations. Broad engineering experience enables us to meet your space limitations and foundation requirements. Our complete line of "fire zone" towers includes:

Steel frame—masonry exterior
Steel frame—steel exterior
Redwood frame—asbestos-cement exterior
Redwood frame—steel exterior

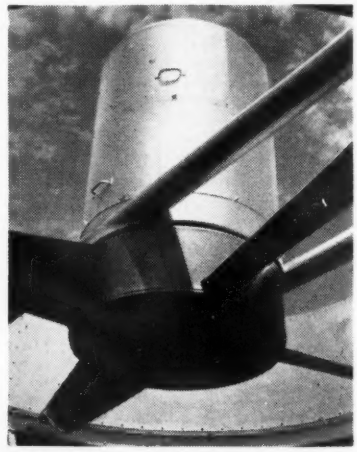
Each is designed for its specific job. Fan drives selected for most efficient application—V-belt drives, right angle speed reducer drives, direct motor-fan drives and the patented Pritchard SEALDFLOW are all available.

For complete information on cooling towers and other Pritchard services, consult our nearest office or see Sweets Files, ASH & VE Guide, ASRE Data Book and other catalogs.

** Names of owners of Pritchard cooling towers in air conditioning and refrigeration service in these cities—and many more in between—will be gladly furnished.*

SEALDFLOW

Pritchard's patented self-ventilated SEALDFLOW fan drive (as illustrated at right) mounts the motor and gears directly on the fanshaft for highest efficiency and complete protection from corrosive action of saturated vapors. Investigate this time-proven, trouble free fan drive! It may be the answer to the mechanical problems on your present tower.



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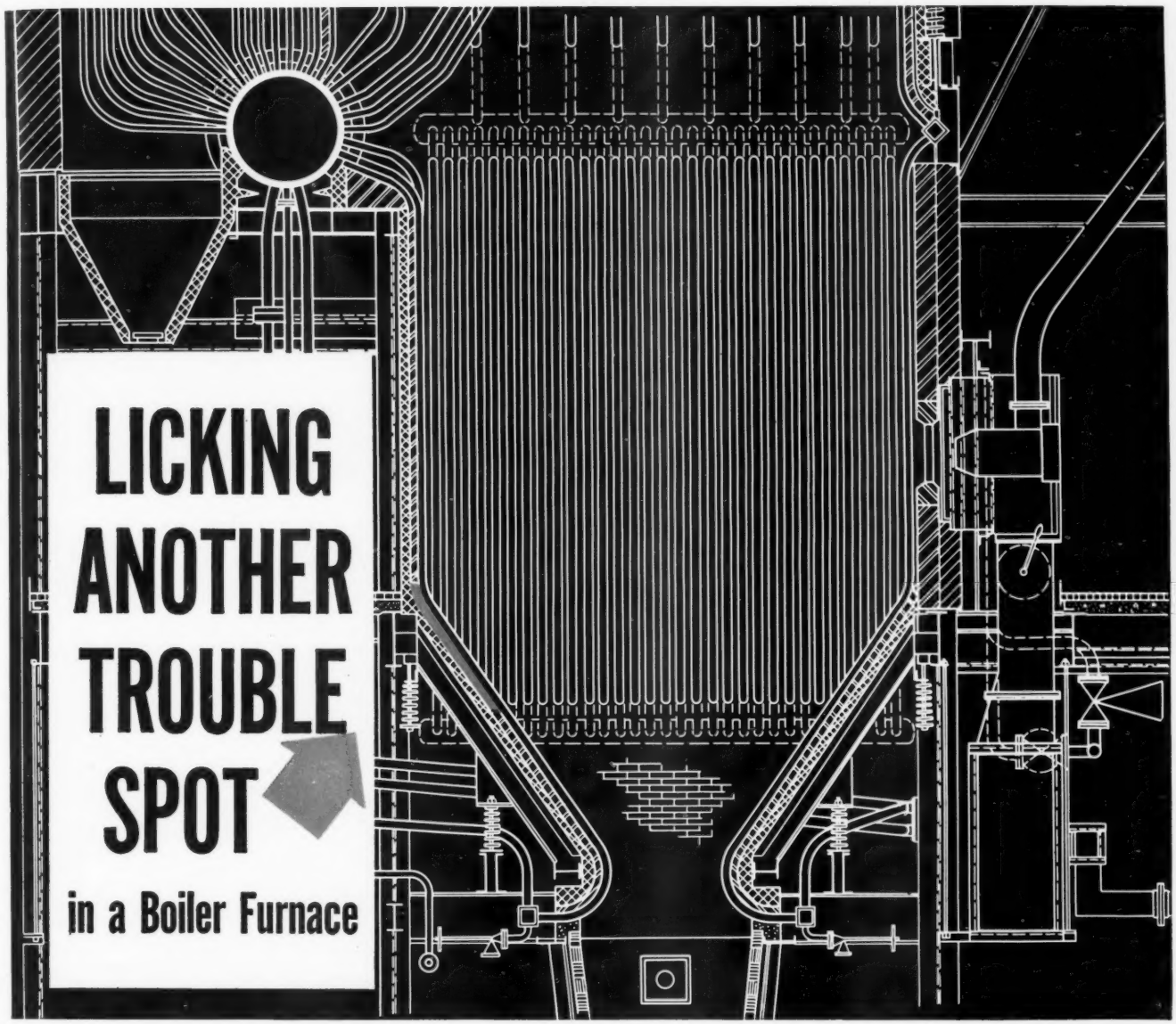


LICKING ANOTHER TROUBLE SPOT

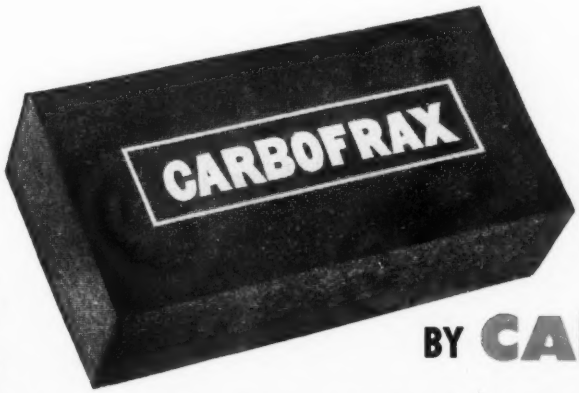
in a Boiler Furnace

The small area, spotlighted in red above, was a source of constant difficulty until it was corrected by the installation of CARBOFRAX silicon carbide blocks.

Slag conditions were particularly bad. Excessive accumulations built up on cast iron blocks located behind and between water tubes. Cleaning with air lances oxidized the metal blocks. Burning thin, they no longer protected backing up refractories and insulation which were soon eroded by impinging flame.

Carbofrax blocks have now been in service over four years . . . more than twice the life of metal blocks. Their appearance indicates several years additional usuage. Costly repairs are eliminated by their outstanding refractoriness . . . resistance to slag penetration and erosion . . . and durability. Continuity of operation is improved. When running on light loads, the radiant face of CARBOFRAX blocks helps maintain ignition.

Trouble spots, in many cases, disappear with CARBOFRAX super refractories on the job. Investigate their use in your settings. Our engineers will be glad to assist. Write Dept. E-98 for prompt attention. The Carborundum Company, Perth Amboy, New Jersey.

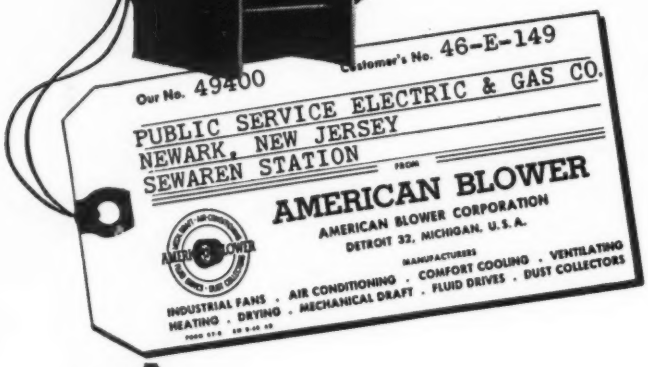


BY CARBORUNDUM

TRADE MARK

"Carborundum" and "Carbofrax" are registered trademarks which indicate manufacture by The Carborundum Company

Sirocco Fans, forward inclined blade type, are especially designed and proportioned for induced draft duty.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Customer's No. 46-E-149
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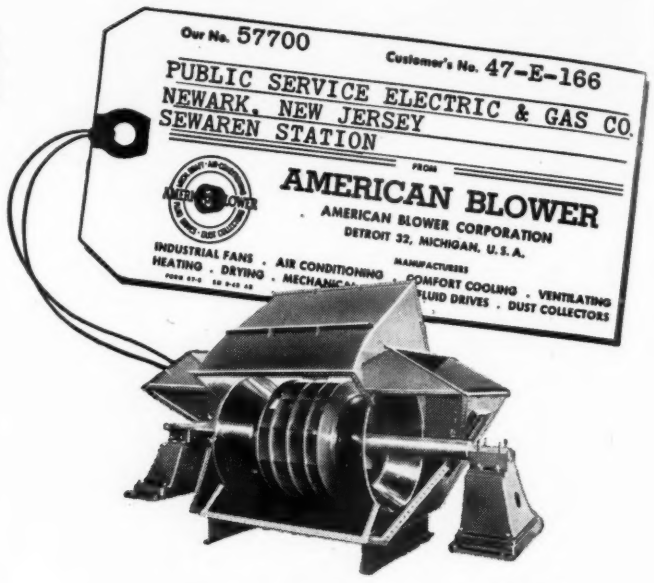
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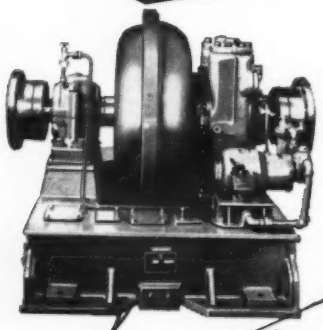
American HS forced draft fans, backward inclined blade type, are particularly suited to forced draft applications.



Type PE Gýrol Fluid Drive—for adjustable speed control of forced and induced draft fans.

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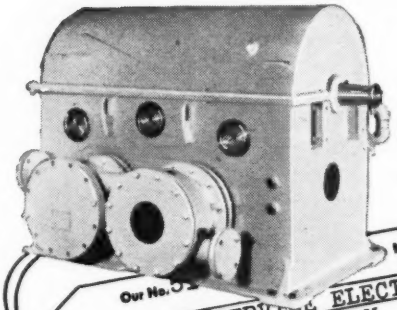
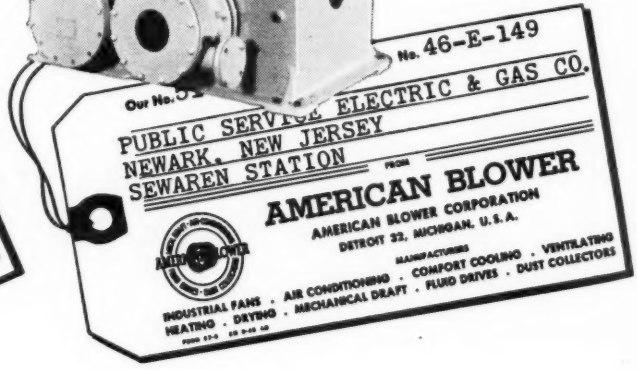


Type VS Class 6 Gýrol Fluid Drive—for adjustable speed control of boiler feed pumps.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Our destination can mean much to you as a power plant operator.

For power plant products, too, are known by the company they keep and by the standing of the companies that purchase them over the years.

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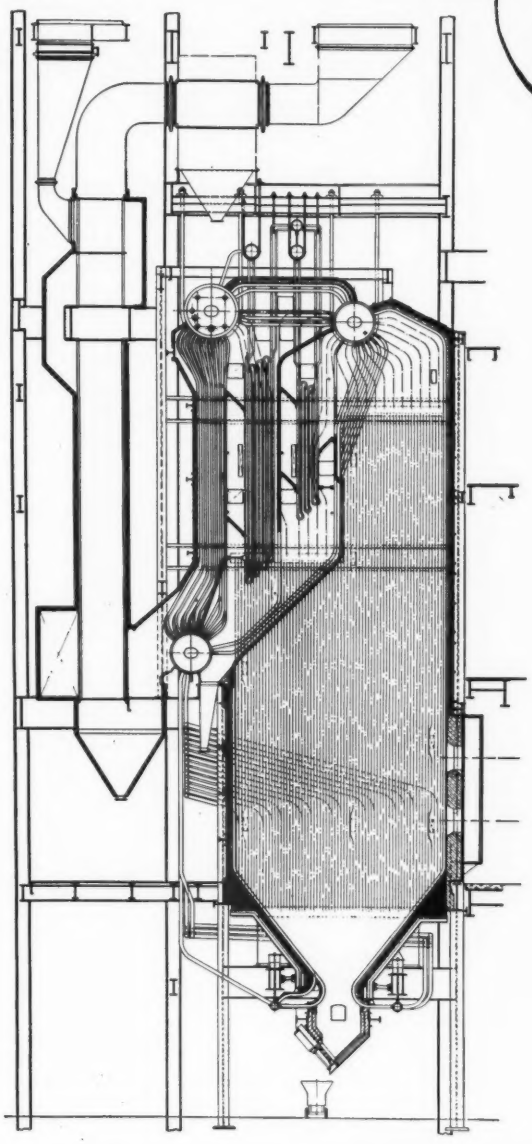
350,000
POUNDS OF STEAM PER HOUR



Purchaser—
Minnesota Power & Light Co.

Location—
Duluth, Minn.

Number of Boilers 1

Type of Boiler
Erie City 3-Drum
Steam Generator

Pounds of Steam/Hr. 350,000

Design Pressure....1025 PSI

Operating Pressure . 925 PSI

Steam Temperature.. 905° F.

Water Walls.....Erie City
Bare Tube

Air Heater.....Erie City
Tubular

STEAM POWER PLANT EQUIPMENT

Complete Steam Generators • Type C 3-Drum Boilers • Type VL 2-Drum Boilers • The "Economic" Boiler with or without Water Walls • Welded H. R. T. Boilers • Welded Steel Heating Boilers • Coal Pulverizers • Underfeed Stokers • Welded Pressure Vessels for the Process Industries.

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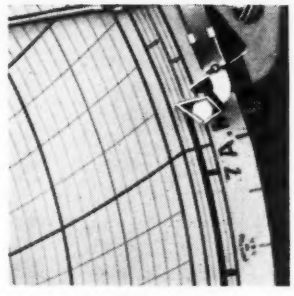
ERIE CITY IRON WORKS • ERIE, PA.

"Is Your Steam Accounting System Just As Antiquated?"

No one would think of firing a modern steam generator in this manner, but many plants are employing methods for approximating steam costs that are equally wasteful and outmoded.

With Brown Recording and Integrating Flow Meters, steam costs for power, processing and heating can be accurately determined—by departments or units and for every hour out of the 24. The dual chart record of rate and quantity immediately reveals any deviation from the most efficient operating standards.

Get the evidence of how steam cost savings are being effected in hundreds of plants. Write for Bulletin 2022—"Brown Flow Meters for Cost Accounting".



AUTOMATIC PLANIMETER. Records units of steam consumption on rim of chart. Shows steam used during any part of a 24-hour period.

INTEGRATOR. Totalizes steam consumption; gives the number of pounds used between successive readings.

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DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR CO.

Offices in principal cities of the United States, Canada and throughout the world.

BROWN *Cost Accounting* **FLOW METERS**

Product of MINNEAPOLIS Honeywell

ANOTHER LEADING PUBLIC UTILITY SPECIFIES . . .

View of boiler front from air-conditioned Control Room in the efficient and modern Industrial Canal Station of the New Orleans Public Service. Shown here are six of the 18 modern Peabody H-26 Combination Gas and Oil Burners installed in this new plant.

PEABODY BURNERS TO FIRE NEW PLANT OF NEW ORLEANS PUBLIC SERVICE

Peabody Equipment has served New Orleans Public Service and other utility leaders for more than 20 years.

One of America's newest and most efficient power-generating plants is the new Industrial Canal Station of the New Orleans Public Service. Eighteen modern Peabody H-26 Combination Gas and Oil Burners are installed in this plant to handle 90,000 lbs. of oil or 1,597,000 cu. ft. of gas per hour, *interchangeably*, and generate more than 1,200,000 lbs. of steam per hour! At this high fuel-firing rate, maximum efficiency is imperative — that's why New Orleans Public Service, like other leading Public Utilities, specified Peabody Burners . . . the standard of efficiency for more than 20 years.

PEABODY
ENGINEERING CORPORATION
580 FIFTH AVENUE • NEW YORK 19, N.Y.

Manufacturers of all types of combustion equipment, direct-fired air heaters, gas scrubbers, coolers, and absorbers.

For further details, write for Bulletins 803 and 903

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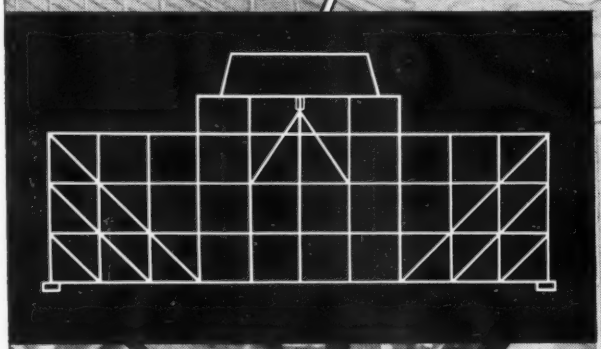
Whatever the Elements Present

Double-Flow
COOLING TOWERS
Are Built To Take It!



Your cooling tower may never have to withstand these elemental furies, but when you install a Marley Double-Flow you have complete assurance that your tower can and will take it. The proof of this is the fact that Double-Flows have been subjected to Atlantic and Gulf hurricanes, mid-western tornadoes, Pacific earthquakes. When the force of wind was spent and seismic shock stilled, Double-Flow towers stood undamaged beside the debris of less sturdily built units.

Designed for 30-pound wind load, Double-Flow towers have safely resisted velocities greatly in excess of that figure. Why? The answer is the built-in SAFETY FACTOR of Marley design. In structural strength, as in functional ability, Marley engineers disregard "allowable minimums" and produce truly safe and properly balanced designs.

Ask your nearest Marley engineering service representative to give you the facts and figures that will let you determine the extent to which Double-Flow towers are designed for safety.

MARLEY COOLING TOWERS

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HOPPES
FEEDWATER HEATERS

Deaerating and Non-Deaerating

Write for Bulletin

The Hoppes Mfg. Co., Inc.

Established 1881

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4223 West Belmont Avenue, Chicago 41, Illinois

MANUFACTURERS OF AUTOMATIC CONTROLS FOR HEATING, AIR CONDITIONING, REFRIGERATION AND NUMEROUS INDUSTRIAL APPLICATIONS. ALSO MERCOID BRAND MERCURY SWITCHES.

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See catalog No. 600 for description of complete line.

DA PRESSURE CONTROLS

Industries' first choice for dependable control performance. The outside adjustment and visible dial eliminate all guesswork when setting the operating range.

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Used on a variety of industrial temperature applications. Have same adjustment feature described above.

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Recommended wherever quiet and dependable performance are essential. Various types available.

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Mercoid brand switches are noted for their superior operating qualities. Various types available.

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Available for gasoline, oil, ammonia or other low specific gravity liquids. Also for liquids at high pressures.

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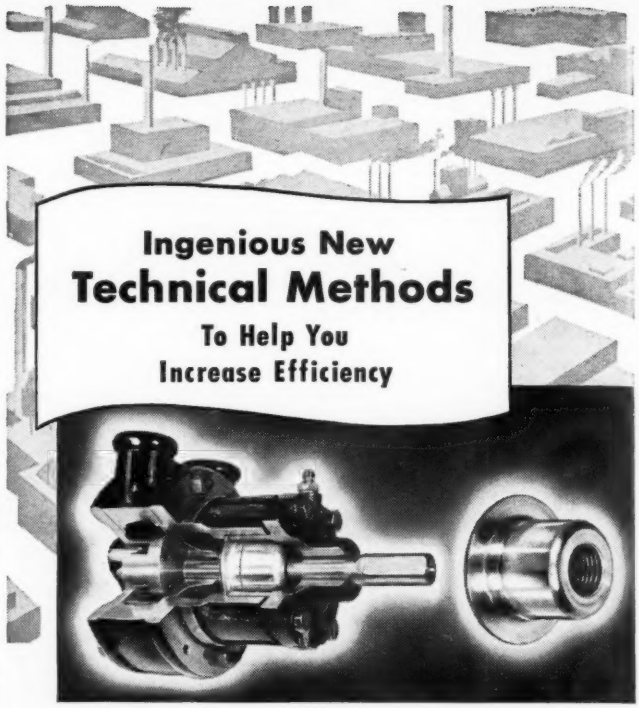
Used for maintaining fluid levels in tanks or for control of sump pumps, etc. Two types, the counter-balance type and plunger type available.

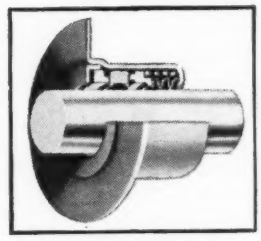
All Mercoid Controls are equipped exclusively with mercury switches—assuring better control performance and longer control life.



New Cartridge Seal Solves Rotating Shaft Sealing Problems

Stepped-up efficiency in sealing of rotating shafts can now be accomplished with a new Cartridge-type Seal mounted on the shaft.

The Cartridge-type Seal shown above is mounted within a Tuthill Pump. The seal contains all parts in one housing cup and insures positive double sealing. A high grade permanent lubricant is contained within the inside chamber of the housing.



Cartridge-type Seal

Surfaces within the Cartridge-type Seal are lapped flat to within a few millionths of an inch to insure perfect mating. And, being a complete unit, only one mounting face is necessary. Clamps are eliminated, and adjustments or alignments are not required. Simply push the Cartridge-type Seal onto the shaft, tighten mounting screws and that's all.

Just as new engineering developments increase efficiency and performance, so can workers' efficiency be increased through the use of chewing gum. The act of chewing helps relieve nervous tension, thus helping to make the work go smoother and easier. That's why plant owners everywhere more and more are making Wrigley's Spearmint Chewing Gum available to all.

Complete information may be obtained from
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200 No. Laflin Street Chicago 7, Illinois

AC-72

The Same Conditions That Make Drinks Drip Cause Conduit Sweating and Wire Failures

Use ROCKBESTOS A.V.C. in Conduit Hot-Spots

—— it's the Cable that RESISTS CONDENSATION

Permanent insulation of impregnated asbestos and high-dielectric varnished cambric, covered with tough impregnated asbestos yarn braid—means, among other things, that it resists moisture.

Every conduit run exposed to high temperatures collects condensation some time or other.

It's a tough combination that does a fast job of ruining ordinary wire and cable. Moisture seeps through cracks in dried out, heat-baked insulation causing grounds, short circuits and expensive re-wiring projects.

But millions of feet of Rockbestos A.V.C. wires and cables in miles of heat-exposed conduit are operating dependably under just such severe conditions. Their impregnated asbestos insulation and braid won't bake out or crack to admit moisture . . . they keep heat away from the varnished cambric . . . and they are highly resistant to corrosive fumes, flame, grease and oil.

WRITE TODAY—for your copy of the new No. 10-F catalog, sectioned for easy reference to permanently insulated Power and Control Cables; Apparatus Wires and Cables; Lighting, Switchboard, Appliance, Fixture, Electronic and Magnet Wires.

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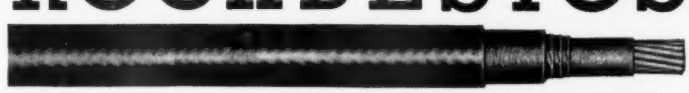
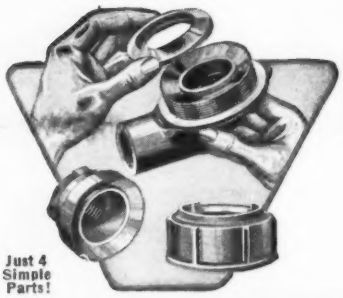
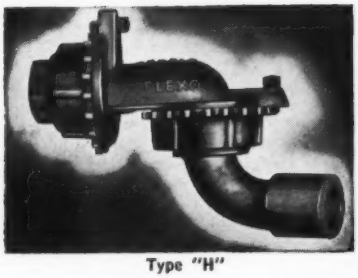


THE WIRE WITH PERMANENT INSULATION



Just 4 Simple Parts!

Handle Pressure with SAFETY *and* FLEXIBILITY *with* FLEXO JOINTS



Type "H"

Flexo Joints combine the flexibility of hose with the strength of pipe for conveying air, liquids, gases or vapors — wherever a swing joint is needed. Flexo Joints handle pressures and temperatures up to superheated steam with unrestricted flow. Made in four styles—each assembled from four interchangeable parts. Standard pipe sizes from ¼" to 3". Swivel movement 360°. Flexo Joints are designed for long wear—no springs—no small parts—maintenance cost is negligible.

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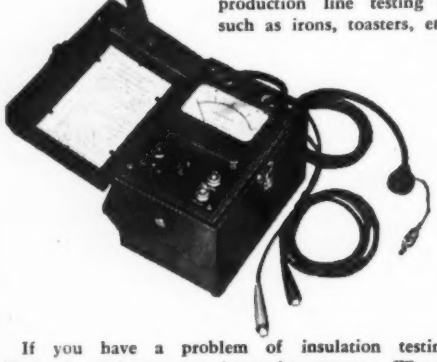
The model 404 shown is a lightweight, portable instrument especially suited to production line testing of appliances such as irons, toasters, etc.



Six models to meet A.I.E.E. specifications are available in 3 KVA capacity. Two models meet A. S. T. M. specifications in 2 KVA capacity.

If you have a problem of insulation testing, Associated Research engineers may have the answer. We will be happy to consult with you.

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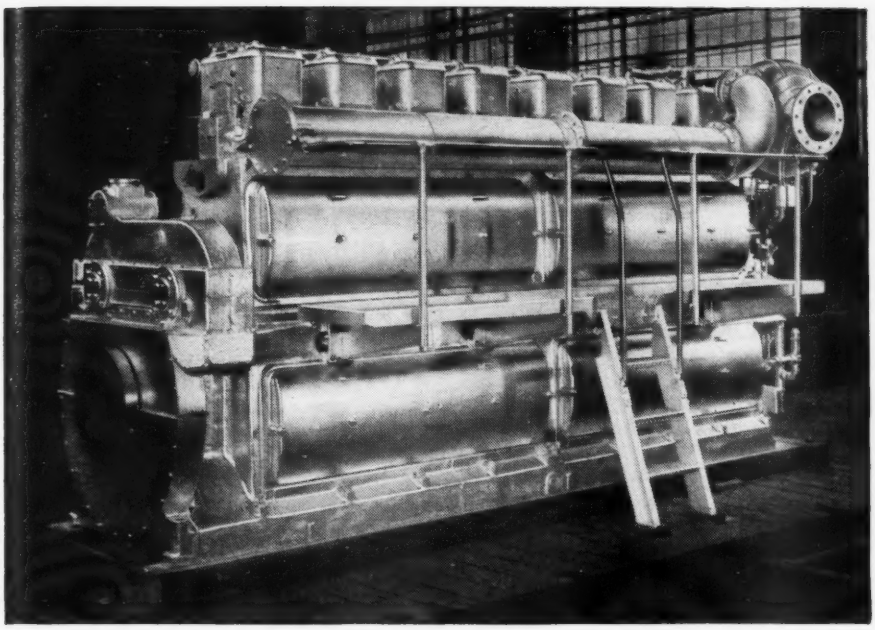

How the ALCO DIESEL PLAN CAN SAVE YOU MONEY

■ The ALCO Diesel Plan is based on ALCO Standardized diesel engines, and offers great economies of construction and operation where multiples of 540 to 1,300 horsepower can be used. The same basic unit provides this wide power range by modifications which permit supercharging. The many advantages of the ALCO design and ALCO plan result in the following economies.

Low First Cost...Because this famous design is also used, with slight modifications, in ALCO switch engines, quantity production brings both first cost and the cost of replacement parts unusually low.

Low Housing Cost...The small physical size and high power-to-weight ratio of ALCO engines means foundations can be smaller and the building space required for housing the engines much less than for engines of lower power-to-weight ratio. The present high building costs make this an important advantage. Together with the low first cost of ALCO engines, the low housing cost means that amortization can be held to a relatively low figure.

Flexibility...The use of one size of engine gives plant operators wide range plus the ability to fit fluctuating load curves more closely than could be done with fewer engines of larger size, or of varied capacity.

Less Wear...This more efficient use of engines means that less wear per installed horsepower is necessary. It will almost always be possible to utilize a lesser portion of the total installed capacity against a given load demand, and the unused portion of *operating* capacity need not at any time exceed about the rating of one engine, with no wear on the idle units. Larger engines would necessitate greater wear per installed horsepower, with resulting higher costs.

Greater Efficiency...With engines operating near rated load, efficiency is greater, fuel consumption less, and better operating conditions are maintained.

Uniform Engine Wear...With several units of the same size, engines can be operated in rotation, thus keeping wear approximately the same in all engines, and allowing a planned program of inspection and maintenance with minimum "down time" and inconvenience.

Stand-by Economy...When all units are the same size, stand-by capacity can be limited to one engine. With a variety of engine sizes, stand-by capacity must equal the largest single unit.

Simplified Maintenance...Uniform engine size means uniformity of replacement parts; uniformity of maintenance and inspection procedures; interchangeability of many parts; smaller stocks of replacement parts; minimum cost of special tools and equipment; and shorter "down time."

Easy Growth...As demand increases, gradual growth can take place by adding extra units of the same size. Where non-supercharged engines are used in the initial installation, increases can be made without changing foundations or building by substituting supercharged engines of the same dimensions.

What About Speed?

Wear...Much has been said about diesel-engine speed versus maintenance. But in actual practice, slow-speed engines and medium-speed engines of the same horsepower rating have almost the same piston-travel and journal-travel per minute.

Thus it seems obvious that wear problems should be very similar—with speed having little influence.

Economy of Space...The space-saving advantage of a medium-speed engine is more than ordinarily important today because of the high cost of buildings—including foundations.

How Much Can You Save?

By using the ALCO plan, and standardizing on ALCO low-cost engines, you can very likely make substantial savings as compared to other approaches to your problem.

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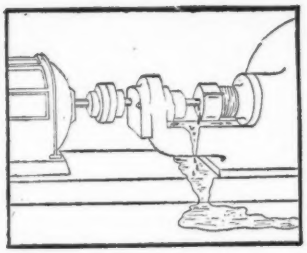

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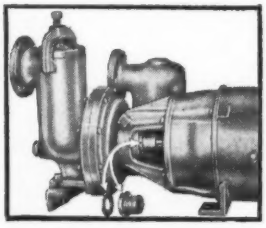

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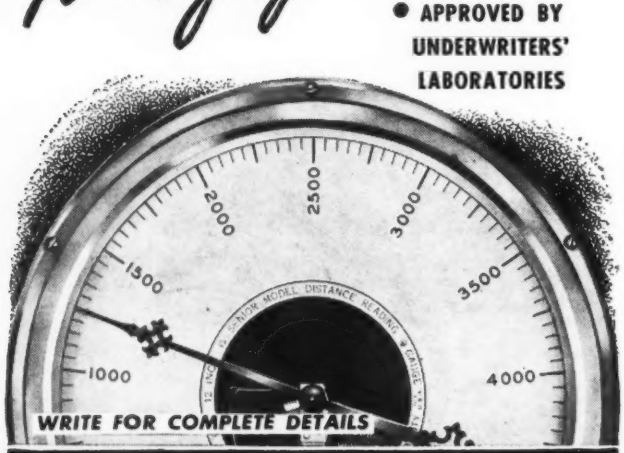

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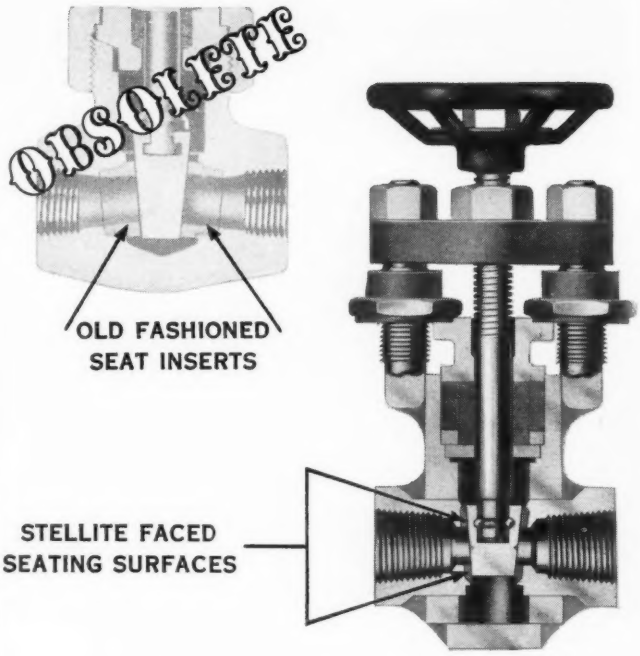

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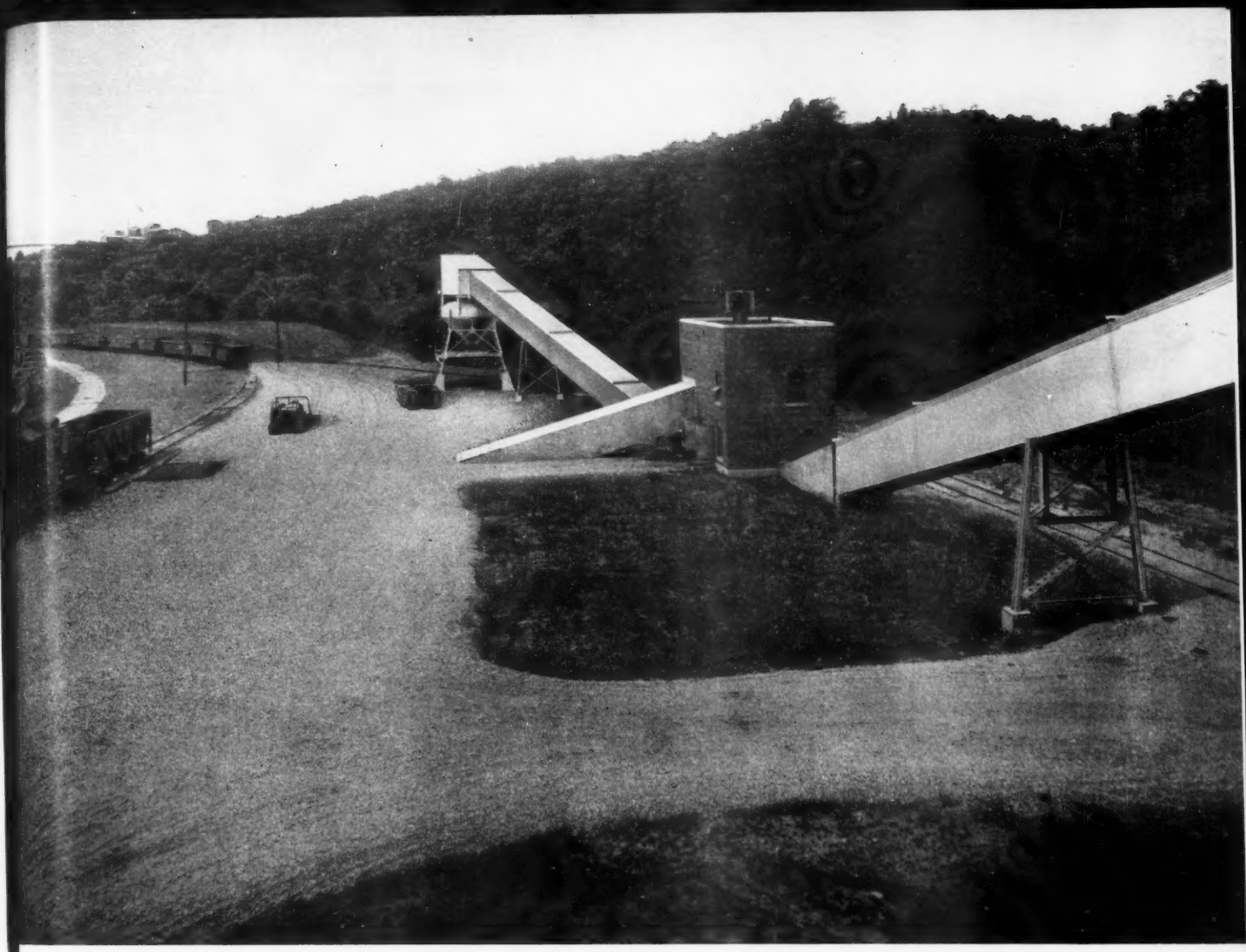

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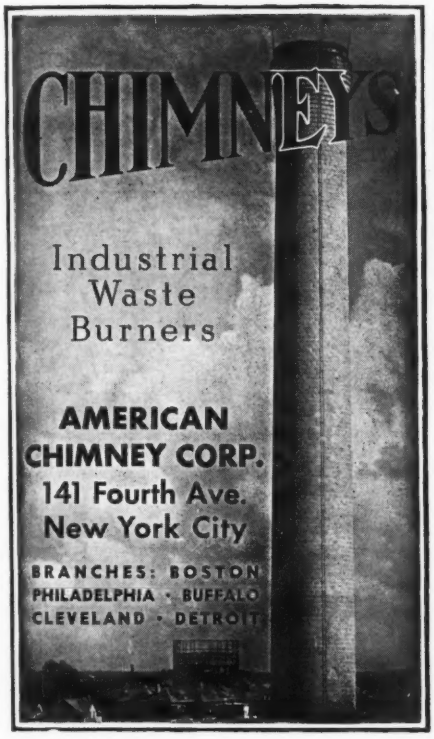

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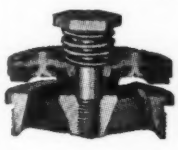

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THESE CHOICE TERRITORIES ARE NOW OPEN

South Atlantic—Middle Atlantic—New England—East No. Central & West South Central Districts

We are an established, leading manufacturer in the welding equipment field. Our nationally advertised line of AC Arc Welders is well accepted and is being sold through progressive jobbers, distributors and dealers. If you are familiar with this field and aggressively cover and have a good following among the Automotive, Hardware, Industrial Supply, Farm Implement and Welding Equipment & Supply Accounts in any one of these territories we have an unusually good money making opportunity for you. Reply in detail outlining your experience and list manufacturers lines you are now handling if any. All replies will be kept confidential.

RW-6125, Power
520 N. Michigan Ave., Chicago 11, Ill.

WANTED

Sales Representatives for nationally advertised

OHIO SEPARATION MAGNETS

Some select territories are still available to live representatives calling on power plants, utilities, etc. Write today to:

THE OHIO ELECTRIC MFG. CO.
5924 MAURICE AVE.,
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REPRESENTATIVES *WANTED*

FOR

COMPLETE LINE

OF

SHELL AND TUBE HEAT EXCHANGERS

- CHEMICAL
- INDUSTRIAL
- DOMESTIC

RW-5737, POWER
330 W. 42nd St., New York 18, N. Y.

SALES OR MANUFACTURER'S REPRESENTATIVE

Established manufacturer of "packaged" boilers and outstanding line of horizontal rotary oil burners has a number of open territories throughout United States. Experience in combustion engineering is desirable. Submit resumé and interview will be arranged.

RW-5822, Power
330 West 42nd St., New York 18, N. Y.

WANTED MANUFACTURER'S REPRESENTATIVE

to contact coal-burning industrial institutions to distribute Today's Coal Bill Reducer (for high pressure boilers) which pays for itself quickly. Sales and combustion engineering experience desirable.
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EMPLOYMENT SERVICES

SALARIED POSITIONS $3,500-$35,000. If you are considering a new connection communicate with the undersigned. We offer the original personal employment service (38 years recognized standing and reputation). The procedure, of highest ethical standards, is individualized to your personal requirements and develops overtures without initiative on your part. Your identity covered and present position protected. Send only name and address for details. R. W. Bixby, Inc., 270 Dun Bldg., Buffalo 2, N. Y.

SALARIED PERSONNEL, $3,000-$25,000. This confidential service established 1927, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. G, 241 Orange St., New Haven, Conn.

ENGINEERS: LARGE college offers $3000., approximately half-time teaching-studying. Position of all ranks for Masters, $4500-$6500. Cline Teachers Agency, East Lansing, Mich.

POSITIONS WANTED

BOILER AND Machinery Inspector with national board commission desires position. Age 41, married. No children. Willing to move anyplace. PW-5777, Power.

HEAT TRANSFER Engineer, Tau Beta Pi, desires responsible position in design or research; 7 yrs. experience in thermal and mechanical design, cost estimating exchanges; in charge of dept. several yrs. PW-5837, Power.

MR. EXECUTIVE: Your piping design headaches are cheerfully traded for a solid place on your staff say as a project engineer, by a man with over 20 years of "know-how" raring to go places with you. PW-5187, Power.

CHIEF OPERATOR. Hydroelectric Power Plant actually employed in Chile, desires change. V. H., Casilla 4050, Santiago, Chile.

EXPERIENCED TECHNICAL Economist, from designer, estimator, equipment purchaser to operation executive with power industries and oil refineries, desires assignment to industrial engineering staff for cooperation in development. PW-6114, Power.

EXPERIENCED MAINTENANCE ENGINEER AVAILABLE

Graduate of Swedish technical school. Thirty-nine years old with more than twenty years practical experience. Served as marine engineer on diesel and steam-driven ships. Chief Engineer U. S. Army Transportation Corps. Experienced in welding, plumbing, lining-up engines, maintenance of fire- and water-tube boilers, refrigeration, fire and safety equipment. Now seeking connection as maintenance engineer in industrial plant where practical knowledge can be applied to save time and money in making repairs and in maintaining plant services economically and efficiently.

PW-5997, Power
330 W. 42nd St., New York 18, N. Y.

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open for one or two good accounts in power and industrial plant equipment and supplies. Established over 20 years. Excellent contacts.

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330 West 42nd St., New York 18, N. Y.

WANTED

Air Compressors Wanted

Horizontal Water Cooled—Any size also 2 Stage portable units

L. W. BAUER
North Bergen, N. J.

WANTED

2 used 90 H.P.—10 x 11—300 R.P.M. Bruce MacBeth Engines.

W-5825, Power
330 West 42nd St., New York 18, N. Y.

WANTED

POWER EQUIPT.

150 to 600-HP Boilers. 300 to 1000 KW Turbo Generator Sets, 150# pressure. 18", 20", 24" x 42" to 48" Corliss Steam Engines. 18" x 7" and 22" x 9" Ingersoll-Rand Vacuum Pumps, 500 and 1000 CFM. AC Engine Generator Sets, 150 to 450 HP. Send full details. Dealers protected.

W-5731, Power
330 West 42nd Street, New York 18, N. Y.

WANTED

BOILERS
DIESELS
TURBO-GENERATORS
POWER EQUIPMENT
What have you to offer?

J. PARKER THOMPSON CO., INC.
507 FIFTH AVE., NEW YORK CITY
MURRAY HILL 7-6547-8-9

WANTED

Compound or triple expansion engine to develop 200 to 500 B.H.P., vertical type preferred, to operate on 125 to 200# Back Pressure or Vacuum; also a turbine with similar operating characteristics for standby power plant equipment with or without generating units, 25 cycle, 3 phase, 550 volts or 2300 volts to ground.
W-6002, Power
330 West 42nd Street, New York, 18, N. Y.

—TRANSFORMERS—

TRANSFORMERS WANTED

in operating condition or burnt out. Mail us list giving complete nameplate data and stating condition.

We Rewind, Repair and Redesign all Makes and Sizes
ALL TRANSFORMERS GUARANTEED FOR ONE YEAR

THE ELECTRIC SERVICE CO., INC.
"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
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A STANDARD OF QUALITY THAT IS NEVER LOWERED

Electrical Equipment

rebuilt and tested by our Electrical Engineers TO N. I. S. A. STANDARDS

TRANSFORMERS

1—Auto, 500 KVA, Packard, 3 phase, 4150 volts, 2—2300 volts.
3—300 KVA, Pitts., 2300 V. Pri., 115/230 V. Sec.
3—300 KVA, G.E., type H, 2300 V Pri., 115/230 V Sec.
300 KVA, Pitts., 7800-440 v.
205 KVA, Whse., 2 phase, 2300 to 3 ph., 4150 autp
200 KVA, Pitts., 4000 v.—110/220.
4—150 KVA, G.E. KS 2300 V. pri., 115/230 V. sec.
100 KVA, Pitts., 1375/2750 v.—110/220.
3—100 KVA, Wagners, 240/120 v.—120 v.
2—100 KVA, Newark, 440 v., 2 phase to 220 v., 3 phase.
2—100 KVA, Whse., 13,800 v. to 250 v.
3— 75 KVA, G.E., 2400 v.—120/240.
6— 50 KVA, Whse., 2400 v.—120/240.
6— 50 KVA, Whse., 13,800 v. to 125 v. or 250 v.
6— 50 KVA, Whse., 6900 v. to 125 v. or 250 v.

A. C. GENERATORS

2500 KVA, Whse., Syn. Cond., 720 RPM, 2400 v.
500 KW, .8 P.F., 3600 RPM, ATB, 600 v.
320 KW, Allis, 450 RPM, 480 v.
240 KW, G.E., ATB, 600 RPM, 600 v.
200 KVA, Allis, 3600 RPM, 240 volt.
200 KVA, Whse., 600 RPM, 240 v.
180 KW, Whse., 514 RPM, 550 v.
165 KW, El. Mach., 514 RPM, 240 V.
100 KW, G.E. ATB, 600 RPM, 240 v.
75 KW, Whse., 900 RPM, 220 v.
62½ KW, Allis, 3600 RPM, 220 v.
7— 50 KVA, Whse., 900 RPM, 220 v.
3— 35 KWA, Columbia, 1200 RPM, 240 v.
1— 31.3 KVA, America, 1200 RPM, 120/208.
15 KW, Star, 1800 RPM, 220/440.
12.5 KVA, Whse., 1200 RPM, 240 v.

TURBINE BLOWERS

1—Spencer Turbine Blower, 1000 cubic feet, 30 oz. pressure with a 15 H.P., 3600 RPM, General Electric Type FT, 200 volt motor.

1—Bellmore, 550 cubic feet, 7 inch vacuum, with a 20 H.P. 3600 RPM, General Electric, Type K, 220 volt 3 phase motor.

MOTORS, 3 Phase, 60 Cycle

SQUIRREL CAGE

750 H.P., General Electric, 750 RPM, 6600 v., 25 cycle.
450 H.P., Ridgeway, 900 RPM, 2200 volts.
125 H.P., G.E., KF, 1750 RPM, 2200 v.
125 H.P., U.S., 1200 RPM, Vert., 220 volts.
150 H.P., G.E., KT, 1200 RPM, Vert., 220 volts.
75 H.P., West., CS, 1750 RPM, 440 volts.
60 H.P., Whse., 900 RPM, Vert., 2200 volts.
60 H.P., Whse., 900 RPM, 440 volts.
2— 40 H.P., G.E., 900 RPM, 220 volts.
35 H.P., Whse., 1200 RPM, CS, 2200 volts.
35 G.E., 600 RPM, 550 volts.
25 H.P., U.S., 1800/1200/900/600, 440 volt.
2— 10 H.P., Whse., Gear 440 RPM, 440 volt.

MOTORS, 3 Phase, 60 Cycle

SLIP RING

1—2500 H.P., G.E., Mt. 257 RPM, 6600 V.
450 H.P., G.E., 425 RPM, ITC, 440 volts, 25 cycle.
200 H.P., G.E., MT, 440 volt, BB, 720 RPM.
100 H.P., G.E., IM, 440 volt, 25 cycle, 720 RPM.
75 H.P., Whse., CW, 720 RPM, 440 volt.
75 H.P., G.E., MT, 1200 RPM, Vert.
50 H.P., G.E., MT, 600 RPM, 220 volt.
2— 50 H.P., Whse., CW, 900 RPM, 220 volts.
40 H.P., Cont., 1200 RPM, JA85, 220 volt.
40 H.P., G.E., 1200 RPM, MT, 220 volt.
40 H.P., G.E., 900 RPM, 220 Volt, ITC.
40 H.P., G.E., 900 RPM, MT, 900 RPM, 220 volt.
40 H.P., G.E., 900 RPM, 2200 volt.

AIR COMPRESSORS

312 CFM, 100 lb. Ingersoll Rand, model 75, with motor.
795 CFM, 150 lb. Chic. Pneu. Duplex, with synchronous motor.

LARGE STOCK OF

D.C. MOTORS AND GENERATORS

SYNCHRONOUS MOTORS

4—200/100 H.P., Whse., 720/360 RPM, 4150 V.
200 H.P., Whse., 600 RPM, 240 v.
1—150 H.P., G.E., 1800 rpm., 220 V., TS.
75 H.P., G.E., 1200 RPM, 440 v.
70 H.P., Elect. Mach., 180 RPM, 2200 v.
40 H.P., Whse., 1800 RPM, 220 v.
35 H.P., G.E., 1200 RPM, 2200 v.
20 H.P., Whse., 1800 RPM, 220 v.

MOTOR GEN. SETS

1—1000 KW, G.E., 275 volts—4150—720 rpm. Syn.
1—1000 KW, G.E., 600 volts—4150—720 rpm. Syn.
1— 500 KW, G.E., 250 V. 900 RPM, 2300 V. Syn.
1— 500 KW, G.E., 575 V. 900 RPM, 2300 V. Syn.
125 KW, CW, 125 v., 1200 RPM, 2300 v. sq. cage.
100 KW, El. Mach., 125 v., 1200 RPM, 4150 v. syn.
100 KW, G.E., 230 v., 900 RPM, 4150 v. syn.
2— 75 KW, G.E., 125 v., 1200 RPM, 220/440 v.
6— 75 KW, G.E., 60 v., 1200 RPM, 220/440 v.
50 KW, Ridgeway, 550 v., 1200 RPM, 220 v.
25 KW, G.E., AT1, 1800 RPM, 40 HP, 1800 RPM, 230 v.

PLATING M. G. SETS

250 amp., G.E., 5/6 volt, 220 v.
500 Amp., Hansen Van Winkle, 24 volt, 220/440 v.
2500 Apm., Chandeysson, 6/12 v., 400 RPM, Syn., 440 v.
3000 Amp., Chandeysson, 6/12, 400 RPM, syn., 440 v.

ENGINE GEN. SETS

150 KVA, G.E., Ames Uniflow, 220 v., 3 ph., non-cond.
2— 5 KW, Gasoline, Hobart, 1800 RPM, 120 v., 1 ph. cont. engines.
1—200/275 H.P. Gasoline Engine, Van Blerck, 8 cylinder, 1500/900 rpm.

TURBO. GEN. SETS

625 KVA, Westinghouse, 2400 v., 3 phase, non-con.
300 KW, G.E., ATB, 240 v., 3 ph., cond.
60 KW, Whse., 120 v., D.C., cond.
30 KW, Allis, 120 v., D.C., Terry non-cond.

STEAM TURBINES

500 HP., G.E., 3 stage, 165#, 3240 RPM.
800 HP., Terry Tandem type, 720 RPM, red. gear.

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SPECIAL

10—900 HP General Motors, Model 12-567 ATL, 12 cylinders, 744 RPM Diesel engines complete with auxiliaries. Practically new.

TURBINE-GENERATOR UNITS

3 Phase, 60 Cycle

1875 KVA G. E. condensing 250 lbs. pressure, 2300 volts, 3600 RPM complete surface condenser.

1563 KVA Allis condensing 200 lbs. pressure, 600 volts, 3600 RPM complete exciter, condenser, switchboard.

1563 KVA G. E. condensing, 300 to 400 lbs. pressure, 2300 volts, 3600 RPM complete exciter, surface condenser.

1250 KVA Allis automatic extraction condensing 300 lbs., 25 lbs. bleeder pressure, 480 volts, 3600 RPM complete exciter, switchboard and condenser.

1250 KVA G. E. condensing, 250 lbs. pressure, 480/600/2300 volts, 3600 RPM complete shaft exciter, switchboard and surface condenser.

1250 KVA G. E. condensing 200 lbs. pressure, 4150 volts, 3600 RPM complete exciter, condenser, panel.

625 KVA G. E. condensing, 150-175 lbs. pressure, 480 volts, 3600 RPM complete exciter, switchboard, surface condenser.

625 KVA G. E. non-condensing, 150 lb. pressure, 15 lbs. back 2300 volts, 3600 RPM complete exciter, panel.

500 KVA Westg. non-condensing 150 to 250 lbs. pressure, 15 lbs. gauge, 240 v. complete exciter, switchboard instruments.

375 KVA (2) G. E. condensing 400 lbs. pressure, 450 volts, each complete exciter, switchboard, surface condenser.

375 KVA G. E. condensing 125 lbs. pressure, 2300 volts, 3600 RPM complete surface condenser and panel.

125 KVA G. E. non-condensing, 175 to 200 lbs. pressure, 10 lbs. gauge back, 2300 volts, 3600 RPM complete.

100 KVA Westg. non-condensing, 125 to 150 lbs. pressure, 10 lbs. gauge back, 2400/600 volts, 3600 RPM.

TURBINE-GENERATOR UNITS

Direct Current

2 400 KW, 240 volts direct current Crocker-Wheeler—Worthington 440 lbs. pressure condensing steam turbine-generator units.

200 KW (3) New General Electric 120 volt Marine type turbine generator units.

75 KW Allis Chalmers-Terry, 125 volts, 2400 RPM 150 lbs. pressure non-condensing turbine generator unit.

60 KW (3) new Westinghouse 120 volt Marine type turbine generator units.

MOTOR GENERATOR SETS

1500 KW Allis-Chalmers 550/600 volts, 300 RPM direct current generator direct connected 2190 HP, 3 phase, 60 cycle, 4000/6600 volts synchronous motor.

500 KW Gen. Elec. 275 volt DC, direct connected to 710 HP. Gen. Elec. 3 phase, 60 cycle, 2300 volt, synchronous motor.

62½ KVA G. E. 3 phase, 60 cycle, 2300 volt, 1200 RPM alternator direct connected 75 HP, 3 phase, 60 cycle, 2300 volt motor.

50 KW Westg. 125 volt, 1200 RPM direct current generator direct connected 75 HP, 3 phase, 60 cycle, 2300 volt motor.

DIESEL GENERATOR UNITS

Alternating Current, 3 phase, 60 cycle

375 KVA Fairbanks-Morse, 240 volts, 300 RPM generator direct connected to 450 HP, 300 RPM, 6 cylinder, Model 32-E-14 full Diesel engine complete with switchboard.

(6) 125 KVA Westing., 450 volt, 1200 RPM, direct connected to Gen. Motors Diesel engine.

DIESEL GENERATOR UNITS

Direct Current

4 300 KW, 120/240 volts, 3-wire, 400 RPM Westinghouse direct current generators each direct connected to a 448 BHP Baldwin Diesel engine.

250 KW Crocker-Wheeler, 250 volt, 257 RPM generator direct connected to 360 HP, 6 cylinder late type Fairbanks-Morse full Diesel engine—complete.

125 KW G. E. 125 volts, 720 RPM generator direct connected 210 HP, 6 cylinder Fairbanks-Morse Diesel engine.

100 KW (6) Delco 3-wire, 250 volt generator direct connected to 150 HP, 1200 RPM, 8 cylinder Superior Diesel engine complete with switchboard.

SYNCHRONOUS MOTORS

300 HP 80% P. F. G. E. type ATI, 2300 volts, 720 RPM synchronous motor.

900 HP Allis 3 phase, 60 cycle, 2200 volts, 150 RPM synchronous motor.

STEAM ENGINE-GENERATOR UNITS

Alternating Current 3 phase, 60 cycle

1125 KVA G. E. 480 volts, 150 RPM generator direct connected to 28" x 36" Skinner Unaflow engine.

500 KVA Westg. 460 volts, 164 RPM generator direct connected to 26" x 28" Skinner Unaflow non-condensing engine, 140 to 160 lbs. pressure, 0 to 10 lbs. gauge back.

312 KVA G. E. 480 volts, 180 RPM generator direct connected to 24" 20" Skinner Universal Unaflow engine, 175 to 200 lbs. pressure.

STEAM ENGINE-GENERATOR UNITS

Direct Current

400 KW (2) G. E. 250 volts, 360 RPM generator direct connected to Skinner vertical non-condensing engine, 150 lbs. pressure, 10 lbs. gauge back.

15 KW Crocker Wheeler, 125 volts, 410 RPM generator direct connected to an American Blower vertical engine.

A. C. GENERATORS

500 KVA Westg. 3 phase, 60 cycle, 440/550 or 2300 volts, 514 RPM three bearing belted alternator.

200 KVA Westg. 3 phase, 60 cycle, 2300 volt, 257 RPM engine type alternating current generator with direct connected shaft exciter and switchboard.

300 KVA G. E. type ATI, 2300/440 volts, 720 RPM generator.

SPECIALS

5425 GPM Worthington 70' head, 1800 RPM centrifugal pump direct connected to 125 HP G. E. 3 phase, 50 cycle, 2200 volt slip ring motor.

1 Allis-Chalmers jet condenser suitable for 2000 KW steam turbine-generator unit.

4400 sq. ft. two-pass. Worthington surface condenser.

1250 sq. ft. Elliott surface condenser.

10 ton Capacity Brown hand operated traveling crane with 31'10" span including 150' of I-beams.

Utilities Electrical Machinery Corporation

600 NATIONAL CITY BANK BLDG.
CLEVELAND 14, OHIO

WIRE OR PHONE
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HERE'S WHY WE CAN SAY "Successful Operation GUARANTEED"

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TRADE RE-NU-BILT BELYEA MOTORS MARK

RE-NU-BILT EQUIPMENT

REBUILT IN ACCORDANCE WITH N. I. S. A. STANDARDS

SPECIAL

4—Complete G.E. Amplidyne Controlled Drives Consisting of:

4—125/150 HP — CD — 1235 S — 1750/2200 RPM 250/300 volt D.C. Motors.

2—200 KW—4 Unit M-G Sets each consisting of: 2—100 KW—CD—1345—250 V. gens., 1—300 HP—TS—9732—9200 RPM—440 V. 3 ph. 60 cy. Syn. Motor and 5 KW—250 V. dir. Conn. exciter.
Complete Automatic controls including CR—7061 AC starter, D.C. Controls, Exciter M.G. Sets & Amplidyne sets.

MOTOR GENERATOR SETS

3 ph. 60 cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	1800	G.E.	600	125/250	4000
1	1500	G.E.	600	600	2300/4150
1	1500	G.E.	360	275	2200/4400
1	1250	G.E.	600	275	2300/4000
1	1000	Whse.	514	600	4000
1	1000	West.	514	250	4150
1	1000	Al. Ch.	720	450	2300
2	500	G.E.	720	600	2300/4150
1	500	G.E.	720	600	4400
1	350	G.E.	900	125	50
1	300	G.E.	720	550	2300/4000
1	250	G.E.	720	275	2300/4000
1	250	G.E.	1200	250	440
1	150	Cr. Wh.	1200	250	440
1	100	G.E.	1170	125	220
2	90	G.E.	1800	60	220/440
1	75	Cr. Wh.	1160	250	220/440
1	75	G.E.	1180	125	2300/4000
1	60	Cr. Wh.	1750	250	220/440
1	60	Whse.	1150	60	220/440
1	50	G.E.	1145	125	220
1	50	G.E.	1200	250	2200

FREQUENCY CHANGER SETS

1—1000 KW—GE—2 Unit—3 Brg. Consisting of—1400 HP—4400 V, 3 ph. 25 Cy. Motor and 1000 KW—2300 V.—8 ph. 58.3 cycle gen. with exciter (Gen can be reconnected for 800 KW 3 ph.)

1—320 KW—GE—2 Unit—3 Brg. consisting of 600 HP—440 V., 3 ph. 60 cy., 8 pf. Syn. Motor and 400 KVA .8 pf. type AT—3 ph. 120 cy. 720 volt AC generator with direct connected exciter.

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Type	Volts	Speed
1	5140	Whse.		4150	600
1	4000	G.E.	TSC	2400/4800	900
1	500	G.E.	ATI	480	900
1	3000	Whse.		2400/4800	720
1	3000	G.E.	ATI	2400/4800	720

D.C. MOTORS

HP	Make	Type	Volts	Speed
6—1500	Whse.		525	600
1—1200	Whse.		600	425
1—800/1000	Whse.		450	600/720
1—765	G.E.	MPC	500	1045/1350
1—700	G.E.	MCF	600	150/525
1—650	G.E.	MPC	250	115/145
1—300/400	G.E.	DYNA	250	1325/2500
1—375	G.E.	MPC	230	450/900
1—335	Whse.	MQ	250	300/900
1—250	G.E.	MPC	230	400/500
1—230	Al. Ch.		230	700
1—80/180	G.E.	MPC	240	400/1000
1—150	G.E.	MPC	230	250/450
1—150	Cr. Wh.	CCM	230	300/1050
10—150	Cr. Wh.	83H	230	890
1—150	Cr. Wh.	CMC-65H	230	1150
2—125	G.E.	CO-1832	230	625
1—125	El. Dy.	30S	230	750/1500
1—115	Cr. Wh.	JHL	230	1200
4—101	Whse.	SK	230	485/950
1—100	Whse.	SK-182	230	300/1200
1—50/100	G.E.	CD-175	230	365/730
1—80	El. Dy.	30S	230	500/1500
1—80	Whse.	SK-180	230	450/1200
2— 75	El. Dy.	25-SL	230	750/1750
3— 60/75	Whse.	SK-200	115	300/700
4— 75	Cr. Wh.	53-H	230	860
1— 75	Cr. Wh.	CMC	230	1150/1760
1— 60	El. Dy.	25-S	230	525/1050
2— 60	Whse.	Hoist.	230	415
1— 60	Whse.	SK	230	500/1000
1— 60	Whse.	SK-131	230	500/1500
1— 60	El. Dy.	25S	230	750/1500
2— 50	G.E.	RCP-31B	230	1700
1— 50	G.E.	RC-34	230	1050
1— 50	G.E.	RF-16	230	500/1500
1— 50	Whse.	SK-131	230	500/1500
4— 50	Whse.	Hoist	230	400
1— 50	Whse.	SK-153	230	690/1035
1— 50	G.E.	CD-123	230	675/1035
1— 50	Whse.	SK-170	230	350/1050
1— 50	Cr. Wh.	CMC-8014	230	380/750
1— 50	Rel.	461-T	230	250/1000

5— 40	Rel.	385-T	230	400/500

These units are semi-enclosed, b. brg. motors and part of complete V-S Drive with 40 KW Ind. M.G. Set with 220/440 v. A. C. Motor; exciter and complete control equipment. M. G. and control in steel enclosure.

ROTARY CONVERTERS

60 Cycle

KW	Make	Speed	D.C. Volts	A.C. Volts
1—1500	Whse.	720	600	2300
1—1000	G.E.	900	600	11000
1—1000	Whse.	900	600	11000
1— 750	Whse.	900	600	13200
1— 750	Whse.	720	250	6600
1— 500	G.E.	900	250	2300

SPECIAL—MERCURY ARC RECTIFIERS

1—750 KW—GE—Type RHW—6 Anode 575 V., D.C. Form C with 2300 V., 60 cycle transformer and switching equipment.

1—500 KW—GE—Type RHW—6 Anode 575 V., D. C. Form 8 with 2300 V., 60 cycle transformer and switching equipment.

A.C. MOTORS

3 ph. 60 cycle

SYNCHRONOUS

HP	Make	Type	Volts	Speed
2—3500	G.E.	TS	2300	257
1—2100	G.E.	ATI	4600	510
2—2000	Whse.		2300	120
1—1000	Whse.		2300	189½
1— 900	Al. Ch.	(New)	2200	150
2— 500	G.E.	TS	4150	600
1— 450	Whse.		2300	128.5
2— 450	Whse.		2300	1800
2— 350	G.E.	TS	2200	150
1— 320	G.E.	ATI	2300	600
1— 300	G.E.	ATI	440	720
1— 150	G.E.	TS-7558	2200	720
1— 145	G.E.	ATI	550	720
1— 100	Whse.		550	600
1— 85	G.E.	TS	440	1800

SLIP RING

1—1000	Whse.	CW	2300	700
1— 900	G.E.	IM	2300	880
1— 500	G.E.	IP	550	505
1— 400	G.E.	IM	2200	252
3— 350	Whse.	CW	2200	900
1— 350	G.E.	MT-442Y	2200/4000	253
1— 300	Whse.	CW	440	1750
2— 300	Al. Ch.	3 Brg.	2300	505
1— 250	G.E.	MT-563Y	550	900
1— 250	G.E.	MT-424Y	4000	257
1— 250	G.E.	MT-559S	2200	1800
1— 135	G.E.	IM	2300	700
2— 100	G.E.	IM-16	2200	435
1— 75	Whse.	CW-761	2300	1750
1— 75	F.M.	By-H16B	2300	1750
3— 50	Whse.	CI-638A	220	870
2— 50	Whse.	CIW-504	440	870
1— 50	Rel.	1XM	2300	880
1— 50	G.E.	MT-352	550	600

SQUIRREL CAGE

1— 250	G.E.	IK	440	600
1— 250	G.E.	KT-559	440	1800
1— 200	(New) G.E.	K	2300	1200
1— 200	G.E.	IK	550	865
1— 125	(New) G.E.	KF-TEFC	440	1190
1— 100	G.E.	IK-Vert.	2300	450
1— 75	G.E.	K	2200	1200
1—60/20	Whse.	CS	220	900/450
1— 50	G.E.	KF-405S	220/440	3550
2— 50	Whse.	CS	220	870
1— 50	G.E.	KT-327	2200	1750

Turbo Generators
See our advertisement on page 283

Remember this name **BELYEA COMPANY, INC.**

OUR 40 YEAR REPUTATION IS YOUR PROTECTION

Main Office and Shop
43 HOWELL ST., JERSEY CITY 6, N. J.
Phone — Journal Square 2-3334
Also N. Y. City Line — Rector 2-7150

GLOW ELECTRIC CO

SQUIRREL CAGE MOTORS

HP	RPM	Volts	Make
750	900	6600	Wtg.-CS
350	514	440	GE-I
250	600	2300	Triumph
200	490	2200	GE
200	600	440	Westgh.-CS
150	600	2200	GE
125	340	220	A-C
85	3600	2200	GE
75	900	2300	GE
75	720	2300	Wagner
75	360	220	GE-I
60	3600	2300	GE-KT
60	900	440	GE-KT
50	3600	440	R. & M.
50	900	220	GE
50	720	2300	Wtg.-CS
40	900	2300	Wtg.-CS
40	720	440	GE-KT
35	600	220	FT. Wayne
30	1800	dual	Delco
30	1200	dual	Master
30	720	220	GE-HI
30	514	440	Stanley
25	3600	dual	L-A
25	1800	dual	GE
25	1200	220	Wesche
25	900	440	GE
25	900	220	GE-FTR
25	720	220	Wagner
25	600	440	GE-I
20	3600	dual	GE
20*	1800	220/440	Master
20*	1800	220/440	Wesche
20	1200	440	Al. Ch.
20	900	440	Wtg.-CCL
20	600	220	GE
15	3600	220	GE-KT
15	1800	220	W-E
15*	1800	220/440	Master
15	1200	220	Ridgeway
15	900	220	Al. Ch.
15	600	220	Burke

ENCLOSED SQUIRREL CAGE

HP	RPM	Volts	Make
40	1200	220	Westgh.
30	1800	dual	Delco
30	1200	440	Wagner
20	1200	440	Wagner
15	1800	dual	Delco
15	1200	220/440	Delco-TEFC-BB
7½*	1800	dual	Wagner-TEFC-BB
7½*	1800	dual	Master-TEFC-BB
7½	1200	dual	GE-Hi Slip-TEFC-BB
7½	1200	dual	Delco
7½	1090	220/440	GE-KR, high slip
7½	900	dual	Delco-TEFC-BB
5*	1800	dual	Master-TEI C-BB
5	1800	220	Wagner TE-BB
5*	1200	dual	GE-TEFC-BB
3	3600	440	Wtg.-TE-BB
3	1800	dual	Delco-TEFC-BB
3	1200	dual	Rel-TEFC-BB
3	900	dual	Delco
2	1800	dual	Delco-TEFC-BB
2	1200	220	GE-TE-BB

*New Motor

ENCLOSED SQUIRREL CAGE—Cont'd.

HP	RPM	Volts	Make
2	900	220	Wagner-TE-BB
1½	900	dual	Delco-TEFC-BB
1½	1800	dual	L. Al.-TE-BB
1½	1200	dual	Ref-TE-BB
1	3600	220	Haskins-TEFC
1	1800	dual	Master-TEFC-BB
1*	1800	dual	Delco-TE-BB
1*	1200	dual	Rel-TE-BB
¾	3600	4400	Delco-TE
¾	1800	dual	Wesche-TE-BB
¾	3600	220	Ohio-TE-BB
½	1800	440	Wtg.-TE-BB
½	1800	440	Delco-TE-BB
½	1800	dual	Delco-TE-BB
½	1200	220	Cr. Wh.-TE
½	900	dual	Delco
½	3600	dual	Delco
½	1800	dual	Delco
¼	3600	440	GE-TE
¼	1800	220	Delco-TE-BB
¼	1800	440	Delco-TE
¼	1200	220	GE
¼	600	220	Jeannin

SLIP RING MOTORS

HP	RPM	Volts	Make
500	900	440	GE-3 Brg.
400	1200	2300	Al. Ch.
375	1800	2300	Al. Ch.
250	300	2300	Al. Ch.
235	1800	220	GE-I
60	1800	dual	Al. Ch.
60	900	2300	Burke
60	900	220	Wesche
50	900	2300	Ridgeway
50	900	440	Wagner
50	720	440	Al. Ch.
50	1800	220	GE-MT
40	1200	220	GF-MT-336
40	900	220	Wtg.-HF
40	720	2300	Wtg.-HF
40	720	220	Al. Ch.-ARY
40*	600	2300	Al. Ch.-ARY
40	600	220	Al. Ch.-ARY
40	450	220	Triumph-C
35	1200	220	Westgh.
35	900	220	Al. Ch.
35	900	2300	Ridgeway
35	720	220	GE-I
30	1800	2300	Wtg.-CW
30	1200	440	Wagner
30	1200	2300	Lincoln
30	900	220	GE-MT
30	900	2300	Ridgeway
30	720	220	GE-I
30	600	220	F. Morse-BV
25	1200	2300	Al. Ch.-ANY
25	1200	220/440	Watson-KH
25	900	220	GE-MT
25	600	220	Watson
20	600	440	Westgh.
20	900	2300	GE-I

VERTICAL MOTORS

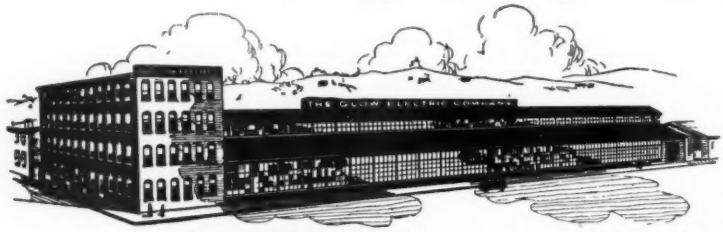
HP	RPM	Volts	Make
200	1200	440	Al. Ch.-SR
150	1200	2200	GE-I
150	1200	440	GE-Cage

VERTICAL MOTORS—Cont'd.

HP	RPM	Volts	Make
125	1200	2300	Al. Ch.-Cage
100	1200	440	GE-Cage
75	1200	2200	GE-Cage
75	360	220	Ideal-Cage
60	1800	230 D.C.	GE
60*	1200	440	Al. Ch.-Cage
50	1800	440	GE-Cage
50	1200	2200	Wtg.-Cage
50	600	440	Al. Ch.-Cage
40	1800	220	GE-Cage
40	1700	230 D.C.	GE
40	1200	440	Wtg.-SR
40	1200	220	GE-Cage
35	1800	440	GE-Cage
35	1200	2300	Al. Ch.-Cage
35	450	440	GE-Cage
30	1200	dual	Wtg.-Cage
25*	1550	230 D.C.	GE
25	1200	2200	GE-Cage
25	850	230 D.C.	Wtg.
20*	1800	440	Al. Ch.
20*	1200	440	Al. Ch.-Cage
15*	1800	440	Al. Ch.-Cage
15	1750	110 D.C.	Wtg.
15	1150	230 D.C.	GE
15	600	440	Al.-Ch.
12½	900	220	L. Al.-Cage
10	3400	230 D.C.	Wtg.
7½	1800	500 D.C.	Peerless
7½	900	440	Burke
7½	700	230 D.C.	GE
6	850	110 D.C.	Rel.
5	1400	230 D.C.	R. & M.
5	600	440	GE-Cage
4	1650	110 D.C.	Watson
3	1700	230 D.C.	Watson
3	1200	dual	Wtg.-Cage

SYNCHRONOUS MOTORS

HP	RPM	Volts	Make
1015	500	2200	Wtg.-25 cycle
700	500	11000	GE-25 cycle
600	750	440	GE-25 cycle
500	600	4160	GE
350	750	4000	GE-25 cycle
300	900	440	GE-sgl. bear
250	225	2200	GE-TS
250	600	2300	GE-ATI
250	225	2200	GE
250	225	440	GE
200	600	2300	GE
200	225	2200	Wtg.
160	600	440	GE-ATI
115	164	208	GE
60	360	2200	GE
50	1200	440	Wagner
50	360	440	GE
30	900	440	Wagner
30	600	550	GE
30	450	dual	Wtg.
30	360	550	GE
30	327	220	E-M
25	1800	220	Wagner
25	450	220	E-M
25	300	220	Ideal
20	900	220	Wtg.
20	600	220	E-M
15	1800	220	Wagner
10	1800	220	Wagner
10	1200	220	Wagner
7½	1200	410	Wagner



D. C. MOTORS

115 Volts

HP	RPM	Description
225	750	GE-MFC
60	200	Star
35	975	Northern
35	610	GE
30	200/600	Sprague
25	1150	Triumph
25	750	GE
20	700	Triumph
20	500/1500	GE-RF11
20	400/1200	GE-RLC fr. 202A
15	1200	J. & L.
15	1100	Westgh. SK80L
15	1000	GE-CE
15	975	F-M
15	725	Westgh.-S fr. 6
12	825	Northern
10*	950	Barriet, type E
10	825	C-W-CCM
10	750	R & M type I-10
10	700	J. & L.
10	650	J. & L. type CI
8	1500	Elect. Dynamic (series)
7½	3500	GE, type B
7½	1950	F-M, type CP
7½	1150	F-M, type CP
7½	975	Westgh.-S-3
7½	750	J. & L. type CI
7½	700	J. & L. type CI
7½	500/1500	Reliance-T-66T
7½	500	Westgh.-SK-BB
7½	170/220	Diehl-NG90
5	3600	Star-SF3-BB
5	1800	Wesche-BB
5	950	Swing-E-6

DC MOTORS—Cont'd

5	650/1950	Imperial-HVI
5	535/1070	C-W, type CMC
5	400/1600	Northern-S
5	260	Diehl-BB
2½	575	GE-RC
2½	300/1200	Reliance-34T
2*	3500	American, type I-BB
2	1200	Westgh-SK
2	1000	Triumph
2	900	Watson-AW4B
2	500/2000	GE-CD
1½*	1750	Marathon
1½	600/1800	Watson-BW
1½	500/1500	GE-RA
1	1725	B-B, type DM
1	1150	GE-RC
1	920	Peerless
1	700	F-M, type TR
1	780/1560	C-W, type CM
1	600	Northern

*New Motor

D. C. GENERATORS

125 Volts

KW	RPM	Description
500	750	GE-MCF
300	1500	GE-CC
100	1000	WE-DLC
100	900	C-W-CCD
80	500	J. & L.-G
80	400	J. & L.-G
65	1100	W-E, type ELC-7
60	1200	Star, type SQ single bearing
55	1000	GE-Type TD
35	1165	GE-DLC
31.25	1400	Westgh.-SK-single bearing

D. C. GENERATORS—Cont'd.

30	1200	Al. Ch., single bearing
25	1200	Westgh.-SK, single bearing
25	1100	GE-CI.
25	600	Westgh.-SK, frame 150
25	300	W-E, type B
16.5	1200	Westgh. BB-DS-I
15	3600	GE-BF
15	1100	Al. Ch.
10*	1750	Westgh.-SK-43
9	1100	R. & M.
9	400	F-M
7½	3600	GE-BR
4	750	Westgh.-SK50I.
2	1400	Westgh.
2	1200	Westgh.-SK

D. C. GENERATORS

230 Volyts

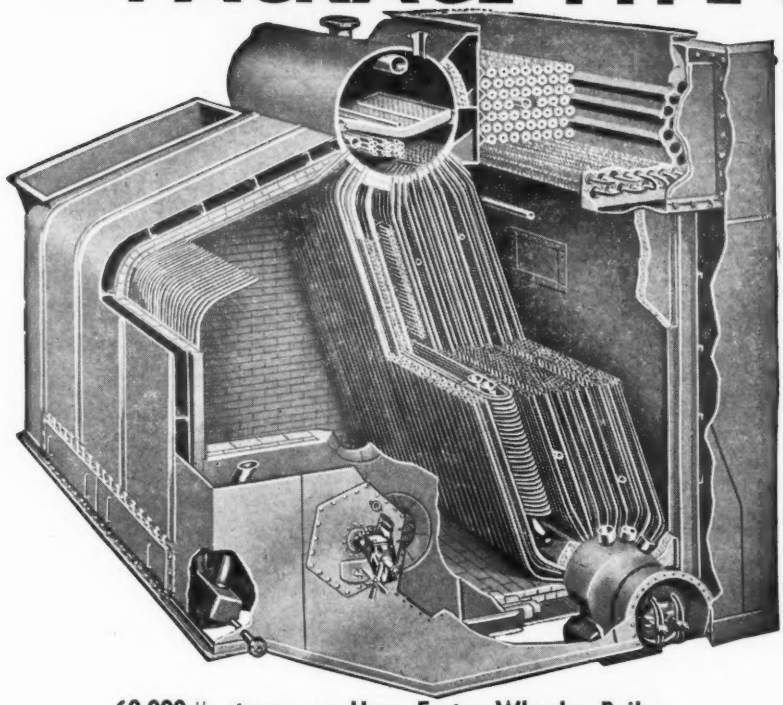
KW	RPM	Description
400	1200	Westgh.
200	375	J. & L.-type K
175	450	Westgh.
125	1400	Westgh.-SK-1301.
80	1050	W-E
35	1800	GE-RC
30	300	Triumph
22½	765	Westgh.-SK
21	890	C & C, type SI.
18	300	Burke
15	350	Westgh.-SK
15	250	GE-CD
5	850	Triumph
1½	900	J. & L.-AI-7
1.2	1750	C-W-CCD

AC & DC MOTORS • GENERATORS • PUMPS
SYNCHRONOUS MOTORS • CONTROL EQUIPMENT
MOTOR GENERATOR SETS • ELECTRIC EQUIPMENT
STEAM ENGINE GEN. SETS • SLIP RING MOTORS

ELECTRIC CO

927 HARRIET ST.
PHONE MA. 3024
CINCINNATI 3, OHIO

PACKAGE TYPE BOILERS



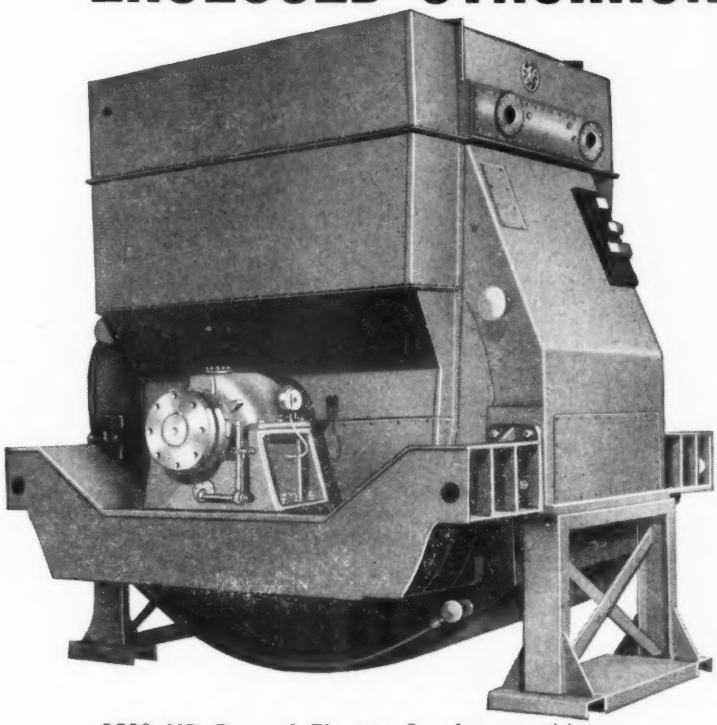
60,000# steam per Hour Foster Wheeler Boiler

4—60,000# steam per hour Foster Wheeler steel-encased boilers, modified "D" type, two drum, bent tube, 435# pressure, 750 deg. total temperature.

Boilers equipped with waterwalls, superheaters, economizers, Swartwout feedwater regulators and Todd oil burners.

The above boilers were built new for the Government in 1943 and are in excellent condition. They are of the package type and can be shipped intact on underslung railroad flat cars.

ENCLOSED SYNCHRONOUS MOTORS



3500 HP General Electric Synchronous Motor

8—3500 HU Unity P.F. General Electric totally enclosed synchronous motors type TSM form HL 3 phase 60 cycle 1700 volts, 257 RPM.

Motors equipped with Griscom-Russell surface air coolers and couplings.

You will note the above motors are at present 1700 volts. However, they can be reconnected for 440 volts or rewound for 2300, 4000 or 6600 volts.

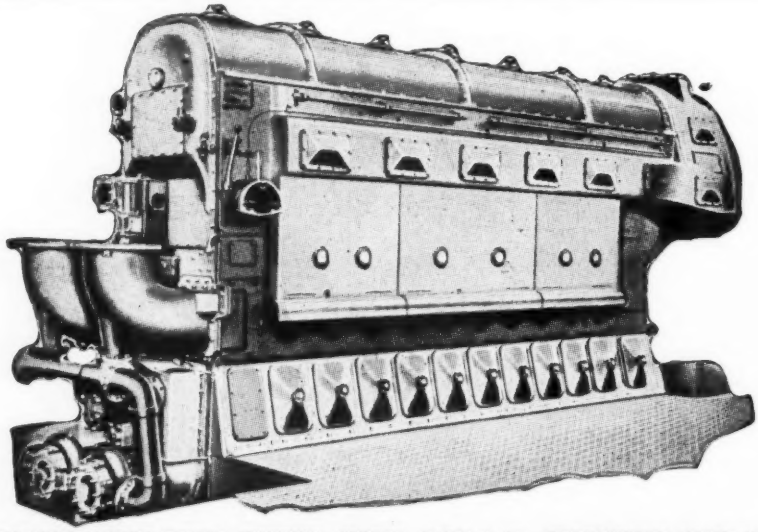
The above motors were built new for the Government in 1943 and are in excellent condition. They are self contained and can be shipped intact on underslung railroad flat cars.

INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BLDG. Telephone: MAin 9514 CLEVELAND 14, OHIO

AUGUST SPECIALS

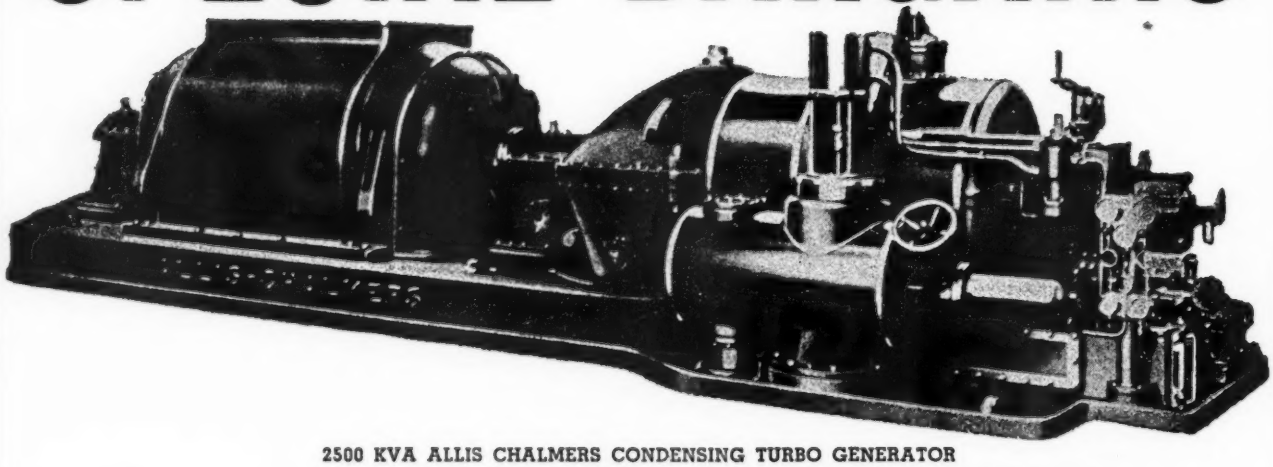
NEW 5000-KVA., G.E., 600#-psi, 750-FTT
Immediate Delivery
Aut. Extr. at 150#: Non-Cond. @ 25#
NEW—On Original Skids. Wire or Phone.
Also: 2—3750-KVA., G.E., New Surf. Condensers: 2—1875 KVA. West. Surf. C.
NEW, NEVER INSTALLED, G.E., 1075-KVA. Geared, 525#-psi. Delvy. Immediate
New 1075-KVA., G.E., 450#psi.-Immediate Delivery



8—FAIRBANKS-MORSE DIESEL ENGINES, MODEL 38D8-1/8; GUARANTEED SAME AS NEW
NEW GENERATORS: IMMEDIATE DELIVERY: COMPLETE UNITS:
4—400-HP. ENTERPRISE DIESEL ENGINES, NEW, NEVER UNBOXED; READY FOR EXPORT

Send Us Your Specifications: Anything Wanted in Diesels?

SPECIAL BARGAINS



2500 KVA ALLIS CHALMERS CONDENSING TURBO GENERATOR

2 Specials

1—2000-KW., 80%-PF., 2500-KVA; NEW BLADING; NEW WINDINGS
1500-KW., 80%-PF., 1875-KVA.; NEW BLADING; NEW WINDINGS
New Condensers, Surface Type; New Auxiliaries
COMPLETE INSTALLATIONS; IMMEDIATE DELIVERY

OUR STOCK IS ONE OF THE LARGEST IN THE WORLD OF GOOD, USED AND NEW POWER PLANT EQUIPMENT

Send Us Your Specifications, Capacity, Voltage Steam-PSI
ALWAYS GET WEAVER CO.'S PRICES BEFORE BUYING: 25 TO 50% SAVING ON ALL NEW ITEMS
Your Cooperation Invited & Appreciated

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4045 Penobscot Building Detroit 26, Michigan

Telephones:
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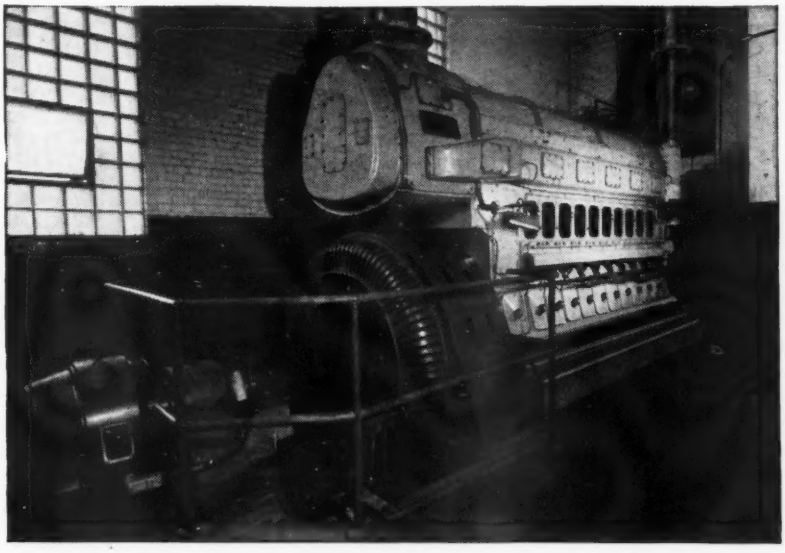
Another AGSCO DIESEL POWER INSTALLATION

IMMEDIATE DELIVERY



Installed and Engineered by A. G. SCHOONMAKER CO., INC., this 1250 KVA, 1000 KW Fairbanks-Morse Diesel Engine Generating Unit is in continuous service at the Park Falls, Wisconsin plant of the Flambeau Paper Co.

A PAPER PLANT like this one at Park Falls, Wisconsin, needs a lot to keep it in operation, but more than any other factor, Power is its life-blood. A. G. SCHOONMAKER engineers were called in to determine how much power was needed for peak operation. After concentrated study and research AGSCO reached a decision and carried through the job of supplying and installing the required capacity Diesel unit. It is this kind of engineering "know-how" and service which has made A. G. SCHOONMAKER stand foremost in the Power Field for over 50 years.

AGSCO maintains a large inventory of Diesel Engine Generating Units in capacities of 10 to 1136 KW designed for heavy duty, continuous service. Write for bulletins and full information today.

A PARTIAL LISTING OF OUR INVENTORY

KVA	Make	Model	HP	RPM	KVA	Make	Model	HP	RPM
*1250	General Motors	16-278A	1600	720	375	Worthington	DH-6	450	450
*1250	Fairbanks Morse	38D8⅛	1600	720	375	Baldwin	VO	448	400
1250	Nelseco	6M1-53	1500	300	375	General Motors	8-268A	450	1200
1250	Cooper-Bessemer	LS-8	1500	327	312	Cooper-Bessemer	FSN-6	375	900
*900	General Motors	12-567	1100	720	300	Fairbanks Morse	Y	360	257
750	General Motors	12-567	900	600	250	General Motors	8-268A	350	1200
625	Superior	OS	750	327	125	General Motors	3-268A	150	1200
*625	General Motors	8-278A	750	720	123	Fairbanks Morse	32E14	140	300
437	De La Vergne	VO	525	450	100	Buckeye	E	150	325 (BC)
400	Ingersoll Rand	S	460	600	62	Int'l Harvester	UD-18	76	1200

*ALSO AVAILABLE AS PORTABLE UNITS

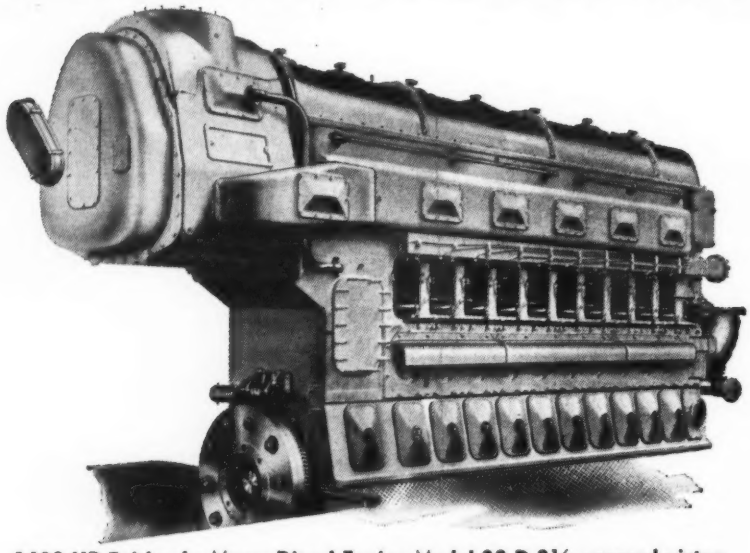
Engineered AGSCO DIESEL POWER

A. G. SCHOONMAKER Company, Inc. ESTABLISHED 1898

Diesel Engines • Power Machinery

50 CHURCH STREET, NEW YORK 7, N. Y. PHONE Digby 9-4350

LIQUIDATION SALE—Modern Equipment



1600 HP Fairbanks Morse Diesel Engine Model 38 D 8⅛ opposed piston

MOTORS

3 Ph. 60 Cy.
6—3800 HP 1700 V 257 RPM G.E.
5— 700 HP 2300 V 128 RPM
D. C.
1500 HP 525 V DC 600 RPM W'hse
667 HP 374 V DC 1300 RPM Elliott
444 HP 250 V DC 900 RPM Elliott
222 HP 230 V DC 3050 RPM W'hse.

GENERATORS

1200 KW 525 V DC 750 RPM All. Chalm.
1075 KW 375 V DC 750 RPM Elliott
700 KW 240 V DC 500/720 Elliott
540 KW 240 V DC 1200 RPM West.
100 KW 120/240 1200 RPM Delco
2250 KW 1700 V AC 257 RPM G.E.
60 KW 115 V AC 1800 RPM G.E.

TURBO-GENERATORS—A.C.

2—750 KW GE, Type ATI, 3/60/450, 1200 RPM, cond., 265# steam press.
2—450 KW, Whse, 3/60/450, 1200 RPM, cond., 250# steam press.
6—300 KW G.E. type ATI 3/60/450, 1200 RPM cond., compl., with 40 KW exciters, condensers, switchboards.
2—250 KW G.E. type ATI 3/60/450, 1200 RPM, cond.
2—200 KW Westinghouse, 3/60/450, 1200 RPM cond. (NEW).
8—200 KW, G.E. type ATB 3/60/450, 1200 RPM cond. and non-cond.
2—132 KW G.E. type ATB 3/60/450, 1200 RPM, cond.

TURBO-GENERATORS—D.C.

KW	Volts	Winding	Speed	Type
3	400	120/240	shunt,	1200 cond.
2	375	180/240	Shunt	1200 non-cond.
12	150	120	Shunt	1200 cond.
20	60	120	Stab. Sh.	1800 cond.
3	25	120	Stab. Sh.	1200 cond.

BOILERS

10—Cleaver-Brooks, 2000# steam pr. hr. 35# press.
6—Cyclotherm 3000 pounds steam per hour, 125# press.
6—Express Boilers, modified D type, Foster Wheeler 30,000# steam/hr., 435# press., with economizers, superheaters, desuperheaters, oil burners, etc.
8—B&W, D type, 580# press., 5400 sq.ft. heating surface.

DISTILLING PLANTS

2—40,000 gallons per day, Foster Wheeler triple effect low pressure.
1—80 tons per day. Condenser Service, double effect.
10—2000 gals. per day Kleinschmidt vapor compression distiller mfd. by Badger.
1—750 gals. per day, same as above.

HYDRAULIC PUMPS

5—Vertical, quintuplex, 4⅜ x 10, 450 gpm at 128 RPM against 2500 p. s. i., mfd. by Aldrich driven by 700 HP synchr. motors 3/60/2300.

CONDENSERS—ALL NEW

1— 8533 sq. ft. 2— 1050 sq. ft
10— 3800 sq. ft. 10— 400 sq. ft
3— 3300 sq. ft. 8— 155 sq. ft.
10— 206 sq. ft.—H.P. feed heaters

REDUCTION GEARS

4—1800 HP 2.41:1 10—20 HP 41:1
10— 900 HP 2.48:1 10—11 HP 39:1
10— 25 HP 20:1 10—10 HP 1750:63
7—Waterbury hydr. type K, size 35, 5 and 2A

HOISTS

10—100,000# pull at 10 FPM to 3000# pull at 400 FPM, 2 Gypsies 12000# pull at 125 FPM, driven by 50 HP 230v. D.C. motors 525—1800 RPM.

15—15,000# pull at 78 FPM, 3360# pull at 348 FPM and 2 auxiliary drums. Driven by Chrysler 28.35 H.P. gasoline engines. (NEW).

AXIAL FLOW FANS

10,000 CFM, 3" S.P. 3/60/450 motors
5,000 CFM, 3" S.P. 3/60/450 motors
Rugged construction, acid resisting vanes, totally enclosed motors, all NEW

WIRE ROPE SLINGS

⅝" to 2½" various lengths
Also: Steel blocks, treble, 18" Sheave, capacity 15 ts and 30 ts.

DIESEL ENGINES

	Make	Model	H.P.	R.P.M.	Cycle	Cylinders	Bore & Stroke	Year	Reverse Reduction Gear
4	General Motors	16-258S	1800	900	4	16	9½" × 12"	1943	2.41: fluid coupling
2	Hamilton	R.B. 99-D.A.	1600	700	2	9	9 1/16" × 13⅜"	1944	
8	Fairbanks Morse	38 D O/P	1600	720	2	10	8 1/16" × 10"	1944	Reversible, Hydr clutch
8	General Motors	16-278A	1600	720	2	16	8¾" × 10½"	1944	
35	General Motors	12-567ATL	900	744	2	12	8½" × 10"	1942-44	Falk 2.5:1
2	General Motors	8-268A	500	1200	2	8	6½" × 7"	1943	2.54:1
2	Fairbanks Morse	38 O/P	300	1200	2	6	5" × 6"	1936	
4	Buda	6LD468	95	1850	4	6	4¼" × 5½"		Driving Fire Pumps 1000 gpm, 280 ft. head.

Ask For Our Complete 1948 CATALOG

DIESEL GENERATOR SETS—A.C.

									KW	Volts	Cycles	Exciter Phase	Exciter KW	Exciter Volt
3	General Motors	8-268A	350	1200	2	8	6½" × 7"	1943	200	440	60	3	40	120/240
2	General Motors	3-268A	150	1200	2	3	6½" × 7"	1943	100	440	60	3	20	120/240

DIESEL GENERATOR SETS—D.C.

7	General Motors	16-278A	1600	750	2	16	8¾" × 10½"	1943	1200	525	Allis Chalmers Type MHC 2290 AMPS
4	General Motors	12-278A	1200	750	2	12	8¾" × 10½"	1943	1200	240	Elliott
2	General Motors	8-268A	500	1200	2	8	6½" × 7"	1944	375	120/180/240	Westinghouse-
2	Superior	VDMB	215	600	4	5	6" × 12"		125	120/240	Westinghouse
50	Superior	GDB-8	150	1200	4	8	5½" × 7"	1942-44	100	120/240	Delco 3 wire stab. shunt 60° C rise-
4	General Motors	3-268A	150	1200	2	3	6½" × 7"	1943-44	100	120/240	Allis Chalmers 3 wire stab. shunt

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PUMPS . . . FANS . . . BLOWERS . . . SPEED REDUCERS

PARTIAL STOCK LISTING—WRITE, WIRE OR PHONE YOUR REQUIREMENTS

M-G SETS

KW	Mfr.	Input V	Output V
150	Cr. Wheeler*	220/440 AC	250 DC
105	Century b.b.	220/440 AC	70 DC
100	Gen. Elec.*	220/440 AC	125DC
75	Star b.b.*	220/440 AC	250 DC
75	Star b.b.	240 DC	230/460 AC
40	Whse.	220/440 AC	250 DC
40	El. Prod.	220/440 AC	125 DC
35	Gen. Elec.	220/440 AC	48 DC
30	Marble Card	220/440 AC	60 DC
30	Elec. Prod.*	220/440 AC	50 DC
25	G. E. NEW	220/440 AC	125 DC
20	Whse.	220/440 AC	250 DC
20	Cr. Wheeler	220/440 AC	180 cycles
15	Gen. Elec.	220/440 AC	125 DC
9	H. V. W. 1500 Amp.	220/440 AC	6/12 DC

*Synch. motor drive.

D. C. MOTORS

H.P.	Mfr.	Type	Volts	Speed
150	Cr. Wheeler b.b.	TEFC	230	800
100	Whse.	SK181	230	450/900
75	Allis Ch.	E	230	500
75	Whse.	S13L	115	575
75	Gen. Elec.	BRC	115	1150
65	Gen. Elec.	C	230	375/750
60	Allis Ch. New b.b.	EB149	230	520/690
40	Gen. Elec.	RC32	230	1150
40	Whse.	SK	230	1700
40	Whse.	SK133	230	850
35/50	Gen. Elec.	CD123	230	575/1150
30	Whse.	S-7	115	900
30	Whse.	SK160	230	350/1000
30	Star b.b.	SB	230	1750
30	Gen. Elec.	RC31B	230	1150
25	Gen. Elec.	RC31	230	1150
25	Whse.	SK100L	230	1100
25	Sprague dyna.	LC	230	750/2000
25	Chand'son (4)	C13	115	850
25	G.E. b.b. NEW	CDM93	115	1150
20	Gen. Elec.	RF12	230	400/1600
20	Whse.	SK93	230	1150
20	G.E. b.b. NEW	CDM83	115	1750
20	Gen. Elec.	RC11	115	1150
20	Reliance	T	230	850
20	Gen. Elec.	DLC	230	500/1500
20	Gen. Elec.	CD85	230	1150
15	Gen. Elec.	LC	230	550/1100
15	Gen. Elec.	RC	115	1150
15	Roth	85RS	230	1750
15	G.E. b.b. NEW	CDM67	115	1750
15	Gen. Elec.	RC10	230	1150
15	Whse. (5)	SK90	230	825

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
600	Gen. Elec.	MPC	500	750
150	Cr. Wheeler b.b.	TEFC	250	1200
105	Century b.b.	1500a	70	1200
100	Gen. Elec.	RC17	125	1200
80	Reliance	T	250	1150
75	Allis Ch.	E	250	750
75	Whse.	S	125	600
40	Gen. Elec.	RC	250	1500
40	Whse.	SK	250	1150
30	Elec. Prod.	BB	50	1150
30	Gen. Elec.	RC	250	1500
25	Whse.	SK	250	1750
25	G.E. NEW b.b.	CD93	125	1450
24	Whse.	SK	600	850
20	Reliance	T	250	1150
15	Gen. Elec.	RC	125	1200

EXPLOSION PROOF MOTORS—NEW

1—3 HP 1200 RPM	1—10 HP 900 RPM
2—7½ HP 1800 RPM	1—15 HP 1800 RPM
1—7½ HP 900 RPM	2—20 HP 1800 RPM
3—5 HP 1800 RPM	5— 5 HP 1200 RPM

A. C. MOTORS—25 CYCLE

H.P.	Mfr.	Type	Volts	Speed
300	Whse.	Synch.	2300	750
150	Whse.	Synch.	440	750
150	Whse.	HF	440	500
50	G.E. int.	MTC5337	440	750
50	Allis Ch.	ANY	440	1500
50	G.E.	I-K	440	750
25	Howell	SR	440	750

A. C. GENERATORS—60 Cycle

KVA	Mfr.	Type	Volts	Speed
625	Gen. Elec.	ATB	2300	450
500	Allis Ch.	3 brg.	240/480	360
300	Gen. Elec.	ATB	240/480	720
250	Whse.	G	2300	600
156	G.E. 1 brg.	ATB7558	240/480	1200
125	Whse.	G	240/480	720
125	Gen. Elec.	ATB	240/480	300
125	Whse. 25 cycle	G	240/480	750
100	Whse.	G	2300	900
63	El. Machy.	180 cy.	240/480	1800
60	Fl. Machy.		240/480	900
56	Gen. Elec.	ATB	240/480	900
50	Cont. b.b.	S107	120/208	1200
12½	Whse. b.b. NEW		240	1200

A. C. MOTORS—SLIP RING

3 Phase 60 Cycle 220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
1—	600	Gen. Elec.	I-M	360
1—	450	G.E. 3 brg. 2200 V.	I-M	450
1—	300	G.E. 2200 V.	I-M	1800
1—	200	G.E. 2200 V.	IM-15A	720
1—	150	G.E. 2200 V.	I-M	1200
1—	150	G.E. int. duty	ITC-15	720
1—	150	Allis Ch.	ANY	600
1—	125	Wagner 2200 V.	RS	900
1—	100	Allis Ch.	ANY	1800
1—	100	Al. Ch. b.b. NEW	ARY	600
2—	100	Wagner 2200 V.	RS26V	1200
2—	100	Whse. int. 2200 V.	CI856C	600
1—	75	Ideal int.	AVE	1200
1—	75	Gen. Elec.	MT558	600
2—	75	Gen. Elec.	IM-14	600
1—	75	Gen. Elec.	MT337	1800
1—	75	Allis Ch.	ARY	900
1—	50	Howell	SR437	1200
1—	50	Fair Morse	BV	720
1—	50	Gen. Elec. int.	ITC	600
1—	50	Whse. int.	CI	600
1—	50	Gen. Elec.	I-M	720
1—	40	Gen. Elec.	MT336	900
1—	40	Allis Ch.	ANY	450
1—	40	Gen. Elec.	MT327	1800
1—	37	G.E. int.	ITC	600
1—	35	Lancashire	b.b.	1800
1—	30	Gen. Elec.	OMT336	1200
1—	30	Gen. Elec.	MT346	600
1—	25	Triumph	SR	1200
1—	25	Gen. Elec.	I-M	600
1—	20	G.E. int.	MTC5312	900
1—	20	G.E. b.b.	MT503	1800
1—	20	P & H b.b. int.	WT8	1200
1—	20	Gen. Elec.	MT332	720
2—	20	G.E. int.	MTC5302	1200
1—	15	Gen. Elec.	MT502	1200
1—	15	Watson	KHV	720
1—	15	P & H b.b. int.	W7	1200

A. C. MOTORS—SYNCHRONOUS

H.P.	Mfr.	Type	Volts	Speed
667	Gen. Elec.	ATI	2200	450
300	Whse.	G	2200/440	600
250	Ideal	2BC-M4	2200	450
200	Gen. Elec.	ATI	220/440	900
150	Gen. Elec.	ATI	2200	450
150	Gen. Elec.	ATI	220/440	300
150	Gen. Elec.	ATI	220/440	600
125	Whse.	G	2300	900
125	G.E. splprf.	TS955	220/440	1200
100	American b.b.	YGH	220/440	990
75	El. Machy.	BRKT	550	900
60	Gen. Elec.	ATI	220/440	900

A. C. MOTORS—SQUIRREL CAGE

3 Phase 60 Cycle 220 or 440 Volts

Qu.	H.P	Mfr.	Type	Speed
1—	200	Reliance b.b. NEW	C6085	1800
1—	150	Reliance b.b. NEW	14C6085	720
1—	150	Gen. Elec.	I-K	900
1—	150	Whse. 2200 V.	CS771-1C	1800
1—	150	Reliance b.b. NEW	B6085	1200
1—	150	Reliance b.b. encl.	AA	900
1—	150	Fair Morse	B	600
1—	125	Gen. Elec.	IK-16	450
1—	125	Cont. 2200 V. b.b.	SC	1800
1—	125	Rel. TEFC NEW	B6085	1800
1—	100	Rel. TEFC NEW	C5085	1200
1—	100	G.E. b.b. NEW	K504S	1800
1—	75	Reliance TEFC NEW	C5084	1200
1—	75	Reliance b.b. NEW	C505	1800
1—	75	Gen. Elec.	KT329Y	3600
1—	75	Gen. Elec.	I-K	720
1—	75	Whse. hitorq	CS-607	1200
2—	75	Reliance b.b. NEW	C595	1200
2—	60	Reliance b.b. NEW	B504	1800
1—	60	Rel. TEFC NEW	C505	1200
2—	60	Reliance b.b. NEW	C504	1200
2—	60	Whse. H. T.	CS504	1800
1—	60	Wagner b.b.	RP444	3600
1—	60	Allis Ch. 4000/2200 V	AR623	1800
1—	60	Gen. Elec.	I-K	600
1—	50	G.E. TEFC b.b.	KF445	3600
1—	50	Whse. b.b. NEW	CS405S	1800
1—	50	G.E. 2 phase	I-Q	900
2—	50	G.E. NEW b.b. HT	KG405	1800
2—	50	Reliance b.b. NEW	C445	1200
2—	50	Gen. Elec.	KT336	1200
1—	50	Gen. Elec.	KT342	900
2—	50	Whse. hislip	WL607	900
1—	40	G.E. hitorq	FTR532	1200
1—	40	Howell b.b.	SC	1800
1—	40	Al. Ch. 3 speed	ARX	900/600/450
5—	40	Gen. Elec.	KT336	900
2—	40	G.E.	KT	1200
2—	35	Gen. Elec.	I-K	720
2—	30	Howell b.b. speed	SC	1800
2—	30	G.E. NEW b.b.	K365	1800
2—	30	G.E. NEW hitorq	KG365	1800
2—	30	Whse. NEW b.b.	CS405	1200
2—	30	G.E. TEFC b.b.	K404	1800
1—	30	Gen. Elec.	I-K	900
1—	30	Gen. Elec.	KT336	720
1—	30	Wagner	22T8P	900
1—	30	Whse.	CS646	900
2—	30	Reliance TEFC NEW	C444	1200
5—	25	Reliance b.b. NEW	C364	1800
2—	25	Reliance TEFC NEW	B365	1800
2—	25	Reliance b.b. NEW	C404	1200
2—	25	Reliance TEFC NEW	C405	1200
2—	25	Whse. NEW spl. b.b.	CS365	1800
1—	25	Gen. Elec.	IK	1200
3—	25	Whse.	CS646	900
2—	25	Gen. Elec.	I-K	600
1—	20	G.E. TEFC b.b.	K404	1200
1—	20	U.S. NEW b.b.	SC326	3600
1—	20	Gen. Elec.	KT182	3600
4—	20	Reliance b.b. NEW	C364	1800
2—	20	L.A. NEW exp. prf.	EX364	1800
2—	20	Whse. NEW b.b. spl.	CS364	1800
2—	20	Gen. Elec.	KT312	1200
2—	20	Gen. Elec.	I-K	1200
1—	20	Whse.	CS	1200
1—	20	Gen. Elec. b.b.	I-K	900
2—	20	G.E. NEW b.b.	K365	1200
2—	20	Diehl TEFC NEW	INF364	1800
2—	20	Century b.b. 4 speed	SC594	1800
2—	15	Whse. Splashprf.	C3365	1200
2—	15	Whse. TEFC NEW	CS365	1200
4—	15	G.E. NEW b.b.	K324	3600
2—	15	Diehl NEW b.b.	D1326	1800
2—	15	Whse. NEW TEFC	CS326	1800
1—	15	Diehl TEFC NEW	INF365	1200
4—	15	Gen. Elec.	KT302	1200
1—	15	Gen. Elec.	KT512	900
1—	15	L. Allis	OX365	900

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MODERN SKINNER UNIFLOW ENGINE GENERATOR PLANT

Consisting of

1—500 KVA General Electric generator 3 phase 60 cycle 460 volts direct connected to Skinner Universal Uniflow engine, 125-150# steam pressure, 0-5# back pressure, 150 RPM, with full floating piston.

2—250 KVA General Electric generators 3 phase 60 cycle 460 volts direct connected to Skinner Universal Uniflow engines, 125-150# steam pressure, 0-5# back pressure, 200 RPM, with full floating pistons.

1—187½ KVA Crocker Wheeler generator 3 phase 60 cycle 460 volts direct connected to Skinner Universal Uniflow engine, 125-150# steam pressure, 0-5# back pressure, 200 RPM, with full floating piston.

The above units are complete with switchboards, exciter sets and voltage regulator. They are in excellent condition and can be shown in operation.

You will note the generators are at present 460 volts. However, they can be reconnected for 230 volts.

We will sell either the complete plant or individual units.

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MOTORS • GENERATORS • TRANSFORMERS

MOTORS
3 PHASE—25 CYCLE—220 440 VOLTS

H.P.	Make	Type	Frame	RPM
50	Fairbanks Morse	H16B	Ball Bearing	750
75	Fairbanks Morse	H16C	B.B. Slipring	750
75	Gen. Elect.	IK	2200 volt	750
75	Gen. Elect.	IK		1500
100	Allis Chalmers			1450
150	Gen. Elect.	IK-17		365
150	Gen. Elect.	IK-16		480
150	Gen. Elect.	IM-16	Slip Ring	480
150	Allis Chalmers			1450
150	Gen. Elect.	KT	557	1455
400	Gen. Elect.	IM 17A	Slip Ring	730
500	Gen. Elect.	IK		485
600	Gen. Elect.	MT	Slip Ring	490
600	Westinghouse	CS		490

TRANSFORMERS

3—667 KVA New Transformers—O.I.S.C. 13,800 Volts Primary, 480 Volts Secondary, 1 Phase 60 Cycle with Taps.

TRANSFORMERS

3—150 KVA Niagara OISC 2400/120/240 1 Phase, 60 cycle with Taps.
3—150 KVA Niagara OISC 2400/240/480 1 Phase, 60 cycle with Taps.
6—100 KVA Niagara OISC 2400/240/480 1 Phase, 60 cycle with Taps.
3—100 KVA Niagara OISC 2400/120/240 1 Phase, 60 cycle with Taps.
3—75 KVA Niagara OISC 2400/240/480 1 Phase, 60 cycle with Taps.
3—50 KVA Niagara OISC 2400/240/480 1 Phase, 60 cycle with Taps.

FREQUENCY CHANGERS

All Sizes in Stock. 60 cycle to 90 cycle. 100 cycle, 120 cycle, 180 and any other high cycle if desired.

HORIZONTAL & DUPLEX
Compressors & Vacuum Pumps after Coolers, Filters

25 CYCLE MOTORS

1—1270 HP. Gen. Elect. Synchronous Motor Type A.T.I. 3/25/2200 Volts 150 RPM.
1—1900 HP. Gen. Elect. Synchronous Motor Type A.T.I. 3/25/2200 Volts 150 RPM.

MOTOR GENERATOR SETS

2—350 KW General Electric Sets 250 Volts D.C. driven by 500 HP. 3 Phase 25 Cycle motors.

ROTARY CONVERTER

1—2000 KW Westinghouse Booster type Rotary Converter 230 Volt D.C.—3 to 6 Phase, 25 Cycle, 4600 Volt Transformer.

300 HP. COMPENSATORS

2—300 HP. Gen. Elect. Reduced Voltage manually operated Type CR1034, 3 Phase, 60 cycle, 440 volts. Floor Type with undervoltage and overload protection.
1—300 HP. Gen. Elect. Reduced Voltage manually operated Type CR. 1034 K 22 3 Phase 60 cycle 440 volts.

NEW MOTORS

300 New Gen. Elect. & Westinghouse Motors in stock from 1 to 100 H.P.

MOTORS

1—75 HP. Fynn-Weischel Syn. 3/60/440/1200 RPM.
1—100 Gen. Elec. Slipring Type I Form M., 3/60/440/900 RPM.
1—100 HP. Gen. Elect. Type K (New Motor) 3/60/440/1800 RPM.
1—100 HP. Westinghouse Slipring Type CW, 3/60/440/435 RPM.
1—100 HP. Westinghouse Motor Type CS-867A. 3/60/440/885 RPM.
1—100 HP. West. Slipring Type CW 3/60/440/1200 RPM.
1—100 HP. Gen. Elect. Slipring 3/60/440/1200 RPM.
1—200 Gen. Elect. Type KT. 572 3/60/440/600 RPM.
1—200 HP. Gen. Elect. Slipring Type I Form M. 3/25/440/500 RPM.
1—500 HP. Allis Ch. Slipring 3/60/2200/514 RPM.
1—500 HP. Gen. Elect. Type I Form K, 3/25/440/485 RPM.
1—600 HP. West. Motor Type CS, 3/25/550/490 RPM.
1—600 HP. Gen. Elect. Slipring Type MT, 3/25/550/490 RPM.

VARIABLE SPEED MOTORS

2—300/150 HP. General Electric Motors Type BTA.—3 Phase 60 cycle 440 volts 560/280 RPM with controls.

3 PHASE 550 VOLTS 25 CYCLE MOTORS
Write for our stock list of approximately 500—3/25/550 Voltmotors

ERIE ELECTRIC CO., INC. 124 CHURCH ST. BUFFALO, N. Y. CL. 4758

Reliably Rebuilt—YEAR Guarantee

A.C. Squirrel Gage Motors

H.P.	Make	Type	Speed
250	G.E. (2)	K-568	575
150	El. Prod.		1150
147	West.	CS-25 cy.	715
125	El. Prod.		1150
125	West.	CS	600
125	Al. Chal.	AR-630F	450
100	West.	CS-655C	1750
100	West.	CS-752S	1160
100	G.E. (2)	K-544	1175
100	West.	CS	870
100	G.E.	KT-556	865
100	West. (2)	CS	700
75	West.	CS-505S	1750
75	West.	CS-662C	1200
75	L.A.		1150
75	West.	CS	700
60	West.	CS-504S	1800
60	Rel. (2)		870
50	G.E.	FTR-523	3600
50	G.E. (2)	K-445	1150
50	G.E. (2)	XP	1800
50	L.A.	XP	1800
50	West.	CS	860

A.C. Clipring Motors

600	Cr. Wh.	25 cy.	480
100	Wagner	25 cy.	480
75	G.E.	IM	690
60	G.E.	TEFC	720
50	Al. Ch.	ARY	600
50	G.E. (2)		514
40	G.E.	IM	1200
40	G.E.	MT-352	600
30	West (2)	CI	900
30	G.E.	MT-542	720

A.C. Synchronous Motors

600	G.E.		900
400	G.E. (4)	TS	600
50	G.E.		1200

Generators

KW	Make	Speed
150	G.E.	600

D.C. to A.C. Gen.

KW	Make	D.C.	A.C.
25	G.E.	230	220
25	Star	115	120
25	Ideal	115	440
25	El. Mchy.	230	440
7½	Hertner	115	440
5	El. Spec.	110	110

230 V. Variable Speed D. C. Motors

H.P.	Make	Type	Speed
100	Rel.	1050T	400/1000
100	G.E.	CD173	400/1200
75	Cr. Wh.	CMC	375/750
60	G.E.	C	480/1100
55	Cr. Wh.	CMC	165/500
50	West.		250/1000
50	West.	SK	500/1500
40	G.E.	CD	500/1500
35	G.E.	RF	500/1500
25	G.E. (3)	RF12	500/1500
25	G.E.	RF13	400/1600
25	West.	SK140	400/1200
20	G.E. (2)	RF12	400/1200
15	West (3)	SK93	600/1750
15	West.	SK93	600/1200
15	E.D.	108	500/1500
15	West.	SK	250/1500
10	G.E.	RF10	600/1800
10	West.	SK	600/1200
10	G.E.	RF	400/1600
10	G.E.	RF	400/1200

230 V. D.C. Motors

150	G.E.	RC19	800
100	G.E.	CDP	1750
100	Al. Ch.		900
75	West.	SK180	475
75	West.	SK170	635
60	West.	SK160	680
50	West.	SK133	1300
50	Diehl	K10	850
50	West.	SK	750
50	West. (3)	SK160	585
40	G.E.	RC	1750
40	West. (2)	SK103	1750
40	G.E.	RC	1075
35	West.	SK	1150
30	G.E.	RC	1100
30	West.	SK	975
30	G.E. (2)	RC	775
30	West. (2)	SK143	575
30	G.E. (2)	RC33	775
25	Rel.	92T	1150
25	West. (4)	SK113	860
25	E.D.	108	800
20	West.	SK60	1750
20	West.	SK83	1750
20	G.E.	CD	1200
20	Star (2)	SHB30	29

115 V. D.C. Motors

H.P.	Make	Type	Speed
25	G.E.	CDM85	1800
25	G.E.	CDM95	1200
20	G.E.	CD83	1750
20	West.	SK110L	750

600 V. D.C. Generators

KW	Make	Speed
200	Cr. Wh.	900
3C	Burke	1750
30	E.D.	1150

250 V. D.C. Generators

KW	Make	Speed
330	Elliot	1200
500	West.	1100
300	G.E.	1200
200 (3)	G.E. MPC	1200
150	West.	900
150	West.	1180
150	G.E.	600
50	G.E.	1200
30 (3)	G.E.	1750
30	Cont.	1200
25	G.E.	1200
15	G.E.	1750
10	Star	1750
7½	West.	1200
5	West.	1750

125 V. D.C. Generators

KW	Make	Speed
250	G.E.	720
150	West.	900
150	Cr. Wh.	1200
100 (2)	West.	900
100	G.E.	1200
100	El. Mchy.	1200
75	Cr. Wh.	1200
75	Hertner	1150
50	Sturt.	2800
40	Cent.	1450
20	Delco	1200
15	G.E.	1150
10	Rogers	1450
7½	West.	1200
5	G.E.	1750

Low Voltage D.C. Generators

Amp.	Make	Voltage
8000	H-V-W.	6/12
6000	M-B-O'C. (2)	6/12
5000	M-B-O'C. (2)	6/12
5000	Col.	8/16
2000	H-V-W.	6/12
1000	Chandeysson	6/12
1000	Col.	6/12
125	Hobart (8)	7½
1000	H-V-W.	12/24
3000/1500	Chandysson	12/24
300	Star	15
67	Cont..	15
750	Star	15
1000	G.E.	15
800	G.E.	22/23
600	Rel.	24
134	West.	24
175	Cr. Wh.	25
550	Col.	27
1600	G.E.	30
800	G.E.	30
100	G.E.	30
200	West.	30
205	G.E.	32
1000	G.E.	33
205	G.E.	42
24	G.E.	44/54
75	G.E.	50/10
800	G.E.	50
1500	G.E.	50
400	G.E.	60
1500	Century	60
1500	El. Prod.	65
1000	G.E.	75

ONLY PARTIAL LIST—SEND FOR No. 15

EST. 1910 → L. J. LAND INC. ← 39TH YEAR

New England Representative:
BOSTON, MASS.
411 Atlantic Ave.
Phone: Liberty 4300

146 GRAND STREET, NEW YORK 13, N. Y.
PHONE: CAnal 6-6976

South Western Representative
HOUSTON, TEXAS, 1400 Carr St., Phone: Charter 4-6558

Pennsylvania Office
READING, PENNA.
10th & Exeter Sts.
Phone: Reading 2-6866

To EMPLOYERS who advertise for MEN:

WHEN there are many applicants for a single position it frequently happens that the only letters acknowledged are those of the most promising candidates. Others may not receive any indication that their letters have even been received by a prospective employer much less given consideration. These men often become discouraged, will not respond to future advertisements, and sometimes even question their bona fide character.

We guarantee that *every advertisement printed in the Searchlight Section is duly authorized.* It will help to keep our readers interested in this advertising if you will acknowledge every application received, even if you merely return the letters of unsuccessful applicants with, "Position filled, thank you" written or stamped on them. If you don't care to reveal your identity, mail them in plain envelopes.

We suggest this in a spirit of cooperation between employers and the men replying to Positions Vacant advertisements.

★

"Put yourself in his place"

Classified Advertising Division

McGraw-Hill Publishing Co., Inc.

"I wish to acknowledge receipt of your leaflet in which you recommend that letters be written to all applicants—for positions—who have applied by reason of reading an advertisement in your Searchlight Section. I shall be very glad, indeed, to follow your suggestion.

"We are very pleased with the results of our advertisement as we received a large number of applications and were able to secure a well-qualified engineer."

—A Positions Vacant advertiser in the Searchlight Section of a recent issue

"BREW, WOLTMAN OFFERS"

Turbine Units—60 Cy.

2—5625 KVA General Electric Cond. 25 Cy.
1—5000 KVA General Electric Cond.
2—3750 KVA Westinghouse Cond.
1—3125 KVA General Electric Cond.
1—2000 KVA General Electric Cond.
1—1850 KVA General Electric Cond.
2—1250 KVA General Electric Cond.
1—1250 KVA General Electric Non-C.
1— 625 KVA General Electric Non-C.
1— 600 KVA Allis Chalmers Cond.

Water Tube Boilers

1—2000 HP B. & W. 450-lb. Pul. coal & oil.
1—1200 HP Comb. 600-lb. Pul. coal or oil.
1— 519 Titusville 200-lb. Stoker
2— 509 HP B. & W. 200-lb. Stokers
1— 500 HP Union City 400-lb. Pulverizer
1— 418 HP Comb. Engr. 400-lb. Stoker
2— 406 HP Union Iron Wks. 200-lb.

Steam Engine Units—60 Cy.

1—900 KW Hamilton Uniflow
1—450 KVA Ames Uniflow
1—400 KVA Murray Corliss
1—350 KW Allis Chalmers Corliss
2—250 KVA Skinner Uniflow
2—200 KW Skinner Uniflow
1—156 KVA Ames Vert. Uniflow
1—125 KVA Ames Uniflow

D.C. Steam Engine Units

2—750 KW Skinner Uniflow 250 V.
1—300 KW Skinner Uniflow 275 V.
1—275 KW Ames Vertical Uniflow 250 V.
1—200 KW Skinner Uniflow 250 V.
1—200 KW Skinner Uniflow 125 V.
1—100 KW Skinner Uniflow 230 V. 3-wire
1— 75 KW Ames Uniflow 125 V.

Diesel Engine Units

6—1600 HP Fair. Morse 60 cy. 2300 V. NEW gen.
1— 720 HP Amer. Loco. 240 V. DC
1— 625 HP Worth. 240 V. 60 cy. gen.
1— 450 HP Buckeye 450 V. 60 cy. gen.
1— 400 HP DeLaVergne 2400 V. 60 cy. gen.
1— 375 HP Worth. 240 V. 60 cy. gen.
2— 240 HP Fair. Morse 2400 V. 60 cy. gen.

SYNCHRONOUS MOTORS—60 CY.

2—3000 HP G.E. 2300 V. 257 RPM
1— 880 HP G.E. 6600 V. 514 RPM
3— 400 HP Elec. Mcy. 440 V. 600 RPM
1— 300 HP G.E. 2300 V. 600 RPM
1— 300 HP West. 2300 V. 900 RPM
4— 150 HP West. 2200 V. 400 RPM
1— 100 HP G.E. 2300 V. 240 RPM (Super)

INDUCTION MOTORS

1—8000/1000 HP Cr. Wh. S/R 2200 V. FL 895/448 RPM
1—1200 HP Allis Chalmers S/R 2200 V. 440 RPM
1—1000 HP West. S/R 2200 V. 360 RPM
3— 350 HP Elliott S/C 2300 V. 900 RPM
1— 300 HP West. S/R 2200 V. 1800 RPM
3— 200 HP Elec. Mcy. S/C 480 V. 1800 RPM
1— 200 HP G.E. S/R 2200 V. 435 RPM
1— 150 HP Cr. Wh. S/C 440 V. 1800 RPM. NEW.
1— 150 HP Burke S/C 440 V. 1800 RPM. NEW.
1— 150 HP Al. Ch. S/C 440 V. 1200 RPM.
1— 60 HP West. S/C 2300 V. 1200 RPM

MOTOR GENERATOR SETS

1—1500 KW Al. Ch. 600 V. DC 60 Cy.
2—1000 KW Gen. Elec. 600 V. DC 60 Cy.
1—1000 KW Gen. Elec. 275 V. DC 60 Cy.
1— 500 KW Cr. Wh. 600 V. DC 60 Cy.
2— 500 KW Gen. Elec. 250 V. DC 60 Cy.
1— 400 KW Cr. Wh. 275 V. DC 60 Cy.
1— 400 KW Al. Ch. 275 V. DC 25 Cy.
2— 300 KW Al. Ch. 275 V. DC 25 Cy.
1— 250 KW Al. Ch. 275 V. DC 25 Cy.
1— 200 KW Gen. Elec. 60 V. DC 60 Cy.
1— 75 KW West. 125 V. DC 60 Cy.
1— 75 KW Ridgway 115 V. DC 60 Cy.
2— 75 KW Star 240 V. DC 60 Cy.
1— 18 KW West. 60 V. DC 60 Cy.

ROTARIES—60 Cy.

1—2929/3705 KW Gen. Elec. 225/285 V.
1—2025/2565 KW Gen. Elec. 225/285 V.
1—2000 KW Allis Chalmers 600 V.
1—1500 KW Westinghouse 600 V.
2—1500 KW Westinghouse 270 V.
2—1000 KW General Electric 600 V.
1—1000 KW Westinghouse 240 V.
1— 750 KW Westinghouse 275 V.
1— 750 KW General Electric 600 V.
1— 500 KW Allis Chalmers 600 V.
1— 500 KW General Electric 275 V.
2— 300 KW Westinghouse 250 V.

FREQUENCY CHANGERS

1—6250 KVA G.E. 50/60 cy. 600 RPM
1—1875 KVA G.E. 25/60 cy. 300 RPM
2—1000 KVA G.E. 25/60 cy. 300 RPM
1— 500 KVA West. 25/62½ cy. 750 RPM

TRANSFORMERS—60 Cy.

4—7500 KVA Al. Ch. 33000-13800 V. 3 ph.
3—3750 KVA West. 26400/13200-2400 V.
1—8000 KVA Penn. Auto 26.4/13.2-2.4 KV 3 ph.
4— 333 KVA Al. Ch. 25410/44000-13280/23000Y
3— 750 KVA West. 22000-2300/4600 V.
4— 500 KVA Moloney 13800-240/480 V.
6—3000 KVA Al. Ch. Furnace 13200-200 V.
2— 200 KVA G.E. 11500-220/110 V.
3— 150 KVA Moloney 11000-2300 V.
3— 167 KVA G.E. 7200-12400 Y-2400 or 480 V.
3— 200 KVA West. 6900-230/460 V.
1—1500 KVA West. Auto 4000-2300 V. 3 ph.
1—2500 KVA West. 2400-480 V. 3 ph.
1— 100 KVA G.E. 2300-575 V. 3 ph.
3— 250 KVA Al. Ch. 2300-460 V.
3— 20 KVA West. 2200-575/287½ V.
3— 7½ KVA G.E. 600-120/240 V.
4—27½ KVA G.E. 440-220/110 V.

OIL CIRCUIT BREAKERS

2— 800 A. 87 KV American BB	Outdoor
1— 400 A. 37 KV West. G11	Outdoor
2— 400 A. 25 KV G.E. FK0136	Outdoor
2—1000 A. 23 KV Kelman CB76	Outdoor
4— 600 A. 15 KV G.E. FHK0139BS	Outdoor

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW, WOLTMAN & CO., INC.

50 Church Street New York City 7, New York

TURBO GENERATORS

1—500 K.W., 3 phase, 60 cycle, General Electric non-condensing.
500 KW., 3 phase, 60 cycle, 440 volt Gen. Elec. #39937 with surface condenser, evactor, and switchboard.
750 KW. Gen. Elec., 150 lbs. steam, 10-20 lbs. extraction.

MOTOR GENERATORS

100 KW., 125 volt Gen. Elec. to a 150 HP., 3 phase motor.
80 KW., 80 volt Burke with synch. motor and panels.
50 KW., 250 volt Westgh. to 3 phase synch. motor.

TRANSFORMERS

2—500 KVA, Pittsburgh, 33000 x 13200/6600.
3—400 KVA, General Electric, 13200 x 120/240.
2—150 KVA. Pittsburgh 2300 x 230/460 volt.
2—150 KVA. Pittsburgh 2400 x 120-240 volt.
Over 100 NEW Gen. Elec. up to 75 KVA., 450 x 120 volt.

DC ENGINE GENERATOR

150 KW., 125 volt Crocker Wheeler to a 4 cylinder vertical Ames engine.

MOTORS

Large stock AC & DC motors

CAPACITORS

50—15 KVA, 220 volt, 3 phase, new, General Electric

A. C. GENERATORS TO GASOLINE ENGINES

3—25 KVA, 120 volt, 1 phase, 60 cycle, 900 rpm, Westinghouse, with exciters to LeRoi Gasoline engines with panels, etc.

All above equipment actually in stock. Send for our list of many other items we have.

KEYSTONE
Power Plant Equipment Company

8403 Hegerman St. Phila. 36, Pa.

POWER PLANT EQUIPMENT

(Subject to Prior Sale)

TWO TURBO GENERATORS—Westinghouse, Type 9 CW, Serial 3035-3036 originally built for 200# saturated steam but changed by Westinghouse to carry full load at 150# steam pressure. Air coolers for generators.
781 KVA, 625 KW each; 80% PF—60 cycle, 3 phase, 2400 volts, 3600 RPM.
Including Westinghouse equipment consisting of one Swinging Panel, one Regulator and Field Control Panel, two Generator Panels and one Phase Balancer and necessary Capacitor for operating with the above.

All in excellent operating condition
Immediately available

Contact
MR. H. ELY, *Plant Engineer*

AMERICAN SMELTING AND REFINING COMPANY

PERTH AMBOY, NEW JERSEY

POWER EQUIPMENT—READY TO SHIP

SAVE OVER 50% ON NEW INDUSTRIAL BLOWERS AND VENTILATING FANS

AXIAL FLOW VENTILATING FANS

5—50" dia. 7½" long, 2 sets of propellers, 8 blades to each. Dim: of blade, 14"x 9½" curved mfg'd by International. Size 114, driven by 100 HP., 1750 rpm., 220/440 v. 3 ph. 60 cy. A.C. Motor.

6—16000 CFM Buffalo Forge Co., 3" stat. pres. 1800/1200 rpm. con. 15/4.5 HP., 1710/1150 rpm., 3 ph. 60 cy. G.E. A.C. Motor 220/440 v. totally encl.

2—12000 CFM 3" stat. pres. Sturtevant with dir. con. 10/3 HP., 1775/1180 rpm., 220/440 v. West. CS. TEFC Motor.

1—7500 cfm Clarage with dir. con. 7½ hp., 1750 rpm., 3.3 HP. at 1160 rpm., 220/440 v. 3 ph. 60 cy.

31—6000 cfm Sturtevant Bulletin 512389, 3" stat. pres. 7 blade, dir. con. 5/1.5 HP., 1765/1175 rpm., 220/440 v. 3 ph. 60 cy. West. TEFC Motors.

2—5000 cfm Sturtevant 1.8 stat. pres. 4.2/1.25 HP., 1750/1150 rpm., 3 ph. 60 cy. 220/440 v. ball bearing motors.

2—4000 cfm 3" stat. pres. Sturtevant dir. con. 2 speed, TE Westinghouse 220/440 v. Motors.

A.C. MOTORS—3 PH. 60 CY.

No.	HP	Make	Type	RPM	Volts
1 new	500	Elec. Mach.	Syn'l	120	4000/2200 220/440
1	200	West.	CS	900	220/44
3 new	200	Elec. Mach.		1800	440
1	150	West.	syn.	450	220/440
1	150	West.	syn.	600	220/440
1	150	West.	syn.	900	220/440
2 new	150	Delco	syn.	1200	220/440
4	150	Louis Al.		1800	220/440
1	125	Elec. Mach.	syn.	164	220/440
1	125	West.	CS	680	2200/220/440
2	125	Reliance		600	220/440
1	125	West.	CS	580	2200/220/440
1	100	Reliance		495	220/440
1	100	West.	CS	500	2200
3	100	Elec. Mach.	syn.	720	220/440
1	100	Allis Chal.		1200	220/440
5	100	Master	TEFC	1750	220/440
1	100	West.	CS	1750	220/440
2	85	Reliance		450	220/440
1	75	Stanley		600	220/440
1	75	Elec. Mach.	syn.	900	220/440
1	60	G.E.	KT	1800	550/440/220
1	50	Wagner	(Fynn Weichel)	900	440/220
1	50	American		860	220/440
2	50	G.E.	K-405	1800	220/440

A. C. GENERATORS—3 ph. 60 cy.

1—450 Kva. Elec. Mach. 120 rpm., 4000/2200/220/440 v.

2—NEW 125 kva. Delco, 1200 rpm., 220/440 v.

2—115 kva. Elec. Mach. 720 rpm., 220/440 v.

1—100 kw. Elec. Mach. 164 rpm., 220/440 v.

1—100 kw., West. 900 rpm., 220/220/440 v.

1—100 kw., West. 600 rpm., 220/440 v.

4— 25 kw., O'Nan, 1800 rpm., 220/440 v.

D. C. GENERATORS—250 V.D.C.

3—250 kw., Westinghouse 1200 rpm.

2—200 kw., Reliance, 500 rpm.

8—100 kw., Reliance, 500 rpm.

1—100 kw., West., 720 rpm.

7—100 kw., Delco, 1200 rpm.

1—new 100 kw. Elliot 1200 rpm.

BARGAIN — FOR SALE
100 KW. DIESEL ENGINE GENERATOR SETS

11—100 KW., 120/240 V. D.C. Delco Generators dir. con. to 150 HP., Model GBD-8, 5½x7, 8 cyl. Superior Diesel Engines, elec. starting with muffler, power panel and accessories.

Practically as good as new—Only Used for Spares.

MOTOR GENERATOR SETS—250 V.D.C. 220/440/2200 V. A.C.—3 ph. 60 cy.

No.	KW	Make	RPM
1	250	West.	1200
2 new	100	Delco	1200
1	100	Elliott	1200
1	100	G.E.	900
1 new	100	Elliott	900
1	100	West.	600
1	100	West.	700
1	100	Reliance	580
2	90	West.	680
1	75	Elec. Machy.	720
1	75	West.	720
1	75	G.E.	720
2	50	West.	490
1	50	Cr. Wh.	900
3	40	G.E.	900
2	30	West.	900
1	30	West.	1750
3	10	West.	1750
1	5	G.E.	1750

VARIABLE SPEED MOTORS—230 V. D.C.

No	HP	Make	Type	RPM
2	200	Reliance	1970 T.	400/1200
1	200	West.	SK	400/1200
8	100	Reliance	1050T	400/1000
1	100	G.E.	RC-58	650/1200
2	100	West.	SK-183	575/1150
3	50	West.	SK-180	320/960
3	50	West.	SK	300/1200
1	40	Allis Chal.		400/1200
2	30	G.E.	DLC	400/1200
1	30	West.	SK-130	725/1450
1	30	G.E.	RA-32	800/1200
1	25	West.	SK-123	400/1600
1	25	West.	SK	500/1500
2 new	25	West.	SK-113	600/1200
1	20	West.	SK-110L	400/1600
1	20	West.	SK-123	400/1600

SLIP RING MOTORS—3 ph. 60 cy.

No.	HP	Make	RPM	Volts
2	800	West.	514	2200/6600
1	250	Allis Chal.	900	2200
1 new	200	G.E.	600	440
1	200	West.	1800	220/440
1	150	West.	1150	220/440/2200
1	100	Triumph	580	550/440/220
1	75	G.E.	720	220/440
1	75	G.E.	885	220/440
1	60	G.E.	720	220/440

SURFACE COMBUSTION GARDEN CITY HEAT TYPE EXHAUSTERS

3—#55 Single SSP, 14000 cfm at 1292 rpm., S.P. @ 70 deg. F and 8" water for 1200 deg. F. operation.

2—#50 Single SSP, 10000 cfm at 1375 rpm., S.P. @ 70 deg. F and 8" water for 1200 deg. F. operation.

SPECIAL BARGAIN AIR COMPRESSOR

7—240 CFM Westinghouse type 3 VS-23 3 cyl. vert., 150 lbs. pres. dir. con. to 50 HP., 220/440 or 2200 v. 3 ph. 60 cy. West Slip Ring Motors, auto. control. Can furnish D.C. Motors or Oil or Gasoline Engines if desired.

DYNAMOMETER

"Hi-Eff" hydraulic size 35#, model 58S, 3100 rpm., Taylor Mfg. Co.

FREQUENCY CHANGERS

1—25 kw., 220/440 v. 3 ph. 180 cy., G.E. dir-con. to 25 HP., 1800 rpm., 220/440 v. 3 ph. 60 cy. motors.

SYNCHRONOUS MOTORS

1—New 500 HP., Elec. Machy. Co. 2200/220 or 440 v. 120 rpm.

ENGINE GENERATOR SETS

10—NEW 1 kw. 14.25 v. D.C. and 2 kw., 28.5 v. D.C. Homelite portable gas eng. Gen. sets. Can furnish lamps and batteries. Suitable for farms and camps.

3—5 kva. 120/240 v. 1 ph. 60 cy. Witte Diesel.

1—10 kw., 115 v. D.C. 1200 rpm., Hercules DIESEL.

30—NEW 25 kva. West. 120/208 v. 1 and 3 ph. 60 cy. LeRoi GAS.

1—35 kva. 220/440 v. 3 ph. 60 cy. 257 rpm., Ridgway STEAM.

1—125 kva. G.E. 220/440 v. 3 ph. 60 cy., dir. con. Skinner UNIFLOW Engine.

INDUCTION HEATING CONVERTER

New Van Norman, type indoor, floor, hi-freq. 32 kw. 220 v. 1 ph., 60 cy. 150 A. enclosed type.

WINCHES

240—Winch assembly portable engine hoists, swivel hook, 4¾" l, with 1½" opening and 30' of ¼" cable. Hand cranked, double reduction gear with drum 5¾" w. can be used with A.C. or D.C. Motors.

CAR PULLER or WINCH

1—Welen, 2 drum Winch or Car Puller rated 8600# per drum with 25 HP. G.E. Vertical Motor 230 v. D.C.

GEAR HEAD MOTOR

50 HP., G.E. 220/440 or 550 v., 3 ph. 60 cy., 1755 to 13 rpm., splash proof, ball bearing.

SPECIAL ★ NEW A.C. MOTORS
Totally Enclosed—Fan Cooled
220/440 v. 3 ph. 60 cy.

No.	HP	Make	RPM
26	½	Diehl	1725
1	½	American exp. proof	860
10	¾	G.E.	1200
6	2	Louis Allis	1750
4	2	Louis Allis	1200
2	2	American	850
3	3	G.E.	1750
4	3	Allis Chal.	1150
7	5	G.E.	1750
25	5	G.E.	1150
1	7½	Louis Allis	1750
6	7½	G.E.	1200
6	10	G.E.	1750
3	10	G.E. vertical	1750
7	10	G.E.	1150
3	20	Louis Allis	900
1	50	G.E.	1750
5	100	Master	1750

PORTABLE COMPRESSOR

1—315 CFM Ingersoll Rand portable 100 lb. pres. driven by 105 HP Waukesha Oil Engines, 860 rpm.

FOR SALE OR RENT

WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

Rebuilt POWER EQUIPMENT To Meet Fall Production Schedules

A PARTIAL LISTING FROM CHICAGO ELECTRIC'S LARGE QUALITY STOCKS

Special Motor Generator Sets

1000 KW D.C. generator, General Electric, type MPC, 275 volts 514 RPM, direct connected on fac. sub-base, to 1120 KVA synchronous motor, 3 ph., 60 cy., 2300/4600 volts, 514 RPM.

500 KW D.C. generator, General Electric, type MPC, 250 volts, 720 RPM, on factory base with, 710 HP synchronous motor, General Electric, 3 ph., 60 cy., 440 volts, 720 RPM.

2—200 KW variable voltage drives, General Electric, with 200 KW motor generator sets, 250 volts to 3 ph., 60 cy., 440 volts synchronous A.C. with 250 HP General Electric D.C. motor and control panels.

MOTOR GENERATOR SETS

500 KW D.C. generator, General Electric type MPC, 250 volts, speed 720 RPM, Direct-connected on suitable base with,

710 HP synchronous motor, General Electric, 3 phase 60 cycle, 440 volts, speed 720 RPM.

1000 KW D.C. Generator, General Electric, type MPC, 275 volts, speed 514 RPM, Direct-connected on factory sub-base to,

1120 KVA synchronous motor, General Electric, type TS, 3 phase, 60 cycle, 2300/4600 volts, speed 514 RPM.

SYNCHRONOUS MOTORS
3 Phase 60 Cycle

HP	Make	Type	Volts	P.F. %	Speed
1000	West.		2300	100	900
500	E.M.		2300–440	80	514
450	E.M.		440	100	240
400	G.E.	TS	440		600
250	Al. Ch.		2300	80	720
200	Al. Ch.		2300	100	360
200	Al. Ch.		220/440	100	360
100	G.E.	ATB	2200	100	900
75	Al. Ch.		240	100	1200
75	G.E.	ATI	220	100	900
60	G.E.	TS	220	100	1200
15	Cent. (1 ph.)		208	80	1200

A. C. GENERATORS
3 phase 60 Cycle

KVA	Make	Volts	P.F. %	Speed
1125	G.E.	2300	80	257
1000	West.	2300	100	900
750	Cr. Wh.	480		900
560	Al. Ch.	480	80	360
500	West.	480	80	600
200	Al. Ch.	2200	80	720
100	E.M.	240	vert.	150
100	G.E.	2300	100	900
75	Al. Ch.	240	100	1200
60	F. Morse	460		900
50	G.E.	240		1200
10	M. Card	127/220		1200

SLIPRING MOTORS
3 Phase 60 Cycle

HP	Make	Type	Volts	Speed
800	West.	CW	440/6600	507
750	Al. Ch.		4600	450
750	West.	CW	2300	900
600	G.E.	I-M	440	350
450	G.E.	I-M	2200	1200
400	Al. Ch.		440	514
250	Al. Ch.	ARY	220	705
75	G.E.	MT	440	900
60	West.	CW	2300	900
50	L. Allis	GH	220/440	900
50	G.E.	I-M	440	1750
35	G.E.	I-M	440	1140
30	F.M. (vert.)	UAV	220	1800
30	Lincoln	crane	220	900
30	G.E.	MT	2200	1745
30	G.E.	crane	440	1800
20	Al. Ch.	ARY	440	900
15	West.	CW	220	900
15	Al. Ch.	ARY	440	900
10	Ideal	AV	440	1120
7½	West.	CW	440	1160

SQUIRREL CAGE MOTORS
3 Phase 60 Cycles

HP	Make	Type	Volts	Speed
700	G.E.	K	2200/4160	1800
500	West.	CS	6600	514
400	Al. Ch.		2200	900
400	West.	CCL	440	1200
350	West.	CS	2300	900
250	G.E.	K	2200	3600
200	West.	CS	440	900
125	G.E.	K-TEFC	440	1200
125	Al. Ch.	AR	440	435
100	Al. Ch.	AR	440	514
100	Al. Ch.	AR	440	900

MOTOR GENERATOR SETS

KW	Make	AC	DC
1000	G.E.	4600/2300	275/250
500	G.E.	440	250
450	G.E.(3-unit)	2300	125/250
300	G.E.	2300/440	250
200	G.E.	440	250
200	C. Whlr.	2300	125
150	Al. Ch.	220/440	125

TRANSFORMERS

Qua.	KVA.	Make	Ph.	Cy.	Pri.	Sec.
1	2500	Wstghse.	3	60	2400	480
3	1250	Wstghse.	1	60	13200	2400
1	1000	Gen. Elec.	3	60	22000/44000	2416/604
3	1000	Gen. Elec.	1	60	4160/7200	230/460
3	400	Gen. Elec.	1	60	13200	2300
3	150	Gen. Elec.	1	60	33000	480
3	150	Chi. Elec.	1	60	2400/4160	240/480
3	100	Wstghse.	1	60	480/240	120/240
3	100	Chi. Elec.	1	60	2400/4160	240/480

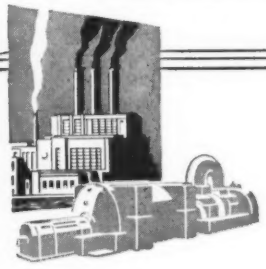
New Dry Type in Stock, from ½ to 50 KVA 1/60

Engineers Rebuilders and Distributors of Fine Power Equipment Since 1910

Write For Stock Listing Catalogue No. 4805-1. Its Free! — No Obligation

CHICAGO ELECTRIC COMPANY

1320 WEST CERMAK ROAD — **CHICAGO 8, ILLINOIS**



TURBO GENERATORS

SPECIAL

ITEM NO. 709,10 Two 100 KW, 60/3/240 volts 150# ISP, one non-condensing, one extraction @ 3# g., built 1932.

ITEM NO. 1544 Extraction and Non-condensing 1000 KW ISP 260#, 550° F. TT. Extraction 125#. Back pressure 30/80# ga. Adaptable to 400#. 60 cycle, 3 phase, 2400/4160 volts. (1935).

NON-CONDENSING

ITEM NO. 876 Three 600 KW, 60/3/480 volts, 160# ISP, 14# g. B.P. Condition: good.

ITEM NO. 952 2000 KW, 60/3/2400 volts, 185# ISP, 40# g. B.P. Condition: excellent. Can supply 1500 KW, 480 volt generator, just rewound.

EXTRACTION

ITEM NO. 432 500 KW, 60/3/480 volts, 150# ISP, 20# extraction pressure. Surface condenser.

CONDENSING

ITEM NO. 62 300 KW, 60/3/120-208 volts. Surface condenser. Westinghouse, built 1929, completely rebuilt at factory 1941—never since used.

ITEMS NO. 36, 751, 500 KW, 600 KW, 60/3/240 volts, both excellent condition.

ITEMS NO. 733, 886, —7 1000, 1500, 2000 KW, 480 volt machines, in good condition. 200# ISP.

ITEM NO. 14 2000 KW, 600 volt unit complete. Reconditioned and sealed for standby.

ITEM NO. 58 750 KW, 2400 volts, GE, built 1922. Surface condenser, and auxiliaries complete. Utility company maintenance. Condition good.

ITEM NO. 1049 2000 KW, 2400 volts, G.E. Utility maintenance, reconditioned and sealed for standby.

ITEM NO. 55 2500 KW, 2400 volts, Westinghouse. Surface condenser and all auxiliaries.

ITEM NO. 908 5000 KW, 2400 volts, G.E. Built 1920. Just completely rebuilt throughout.

ALSO . . .

2000 KW, 50 cycle package steam power plant. Modern. High pressure.

SKINNER ENGINE GENERATOR

900 HP Universal Unaflow. ISP 150/200#. B.P. 10#. 600 KW, 60/3/480 volt generator. 1927.

BOILERS

ITEM NO. 1129 250 HP 160# B & W—3 drum low head. Hand fired. 1934.

ITEM NO. 868 Five 300 HP 180# B & W—4 drum. C. E. Co. Underfeed stoker, one in 1927, four in 1922. All auxiliaries.

ITEM NO. 3 750 HP 250#—4 drum. 7 retort underfeed stoker. New tubes. Built 1927.

ITEM NO. 31 Three 250 HP box header, 160#, oil and gas fired. 1926/30.

ITEM NO. 1228 New Steam Generator, 450# 725°. 150,000#/hr. Pulverizers, oil firing, all auxiliaries—dust collectors, etc. Never installed.

ITEM NO. 601 30,000#/hr. @ 425°, 750°. B & W integral furnace. 1940.

ITEM NO. 972 Two Titusville firebox boilers, 200 HP, 150#, gas fired. 1936.

STOKERS AND FIRING EQUIPMENT

A. Ten Combustion Engineering Co., Type E underfeed stokers. Built 1942 and later. Some new. Others very short operation.

B. Two Fredericks Ram Type Stokers rated 2400# coal/hr. NEW.

C. Two B & W pulverizers, Type E, size 23. Rated 4250# coal/hr. 1942.

TRANSFORMERS

ITEM NO. 828 2500 KVA, 60 cycle, 3 phase, 2400/480 volts. Built 1947; never used.

ITEM NO. 1521 Furnace Transformers. 27,000 KVA TOTAL. Primary 13,200, secondary 160/240.

ITEM NO. 344 Furnace Transformers. Two 4000 KVA, 3 phase. Primary 22,000, secondary 90/260.

ITEM NO. 673 Furnace Transformers. 1000 KVA, 3 phase. Primary 7,200, secondary 90/214.

MG SETS

ITEM NO. 960 Three 100 KW, 250 volts DC; 2300 volts AC. Synchronous.

ITEM NO. 514 Two 1250 KW, 600 volts DC; 4160 volts AC. Synchronous.

ROTARIES

ITEM NO. 816 3250 KW, 250 volts DC; 13.8 KV AC. All auxiliaries.

RECTIFIERS

ITEM NO. 1078 Two—1000 KW, 600 volts DC; 13.2 KV AC. All auxiliaries.

PAUL STEWART and COMPANY

UNION TRUST BUILDING • CINCINNATI, 2 OHIO

SYNCH. CONVERTERS

300 KW G.E. 600 D.C. 1200 RPM. 6 PH. 60 CY. 2300/4000 V. TRANSFORMERS.

MOTOR GENERATORS

500 KW G.E. SYN. 250 V. 2300/4000 A.C. 900 RPM. 3 PH. 60 CY.

500 KW G.E. SYN. 600 V. 2300/4000 A.C. 900 RPM. 3 HP. 60 CY.

400 KW WEST. SYN. 600 V. 2300/4000 A.C. 720 RPM. 3 PH. 60 CY.

300 KW G.E. SYN. 250 V. 2300/4000 A. C. 720 RPM. 3 PH. 60 CY.

250 KW G.E. SYN. 125/250 V 2300/4000 A.C. 720 RPM. 3 PH. 60 CY.

Each unit listed above is owned by us and is available now for immediate purchase.

WALLACE E. KIRK COMPANY

502 Grant Building, Pittsburgh, Pa.

TRANSFORMERS, TURBINES, MOTOR GENERATOR SETS, ROTARY CONVERTERS, BOILERS, CIRCUIT BREAKERS, MOTORS, ENGINE GENERATING UNITS.

We buy and sell Electrical and Steam Machinery. Send us data as to your requirements; also send us description of equipment you have for sale.

ARCHER & BALDWIN, INC.

(Inc. 1917)

75 West Street, New York City 6, N .Y.

FOR SALE

McIntosh & Seymour Tandem Compound Engine No. 1540. 16" diameter high pressure—33" diameter low pressure, 38" stroke, 130 R.P.M., rated 500 h.p. Has with it Twin Beam Vertical Marine Jet Condensor Pump 10 x 15 x 22.

CRANE & CO., INC., Dalton, Mass.

FOR SALE

COMPLETE 2500 KW STEAM POWER PLANT

consisting of two, 1250 KW 3-phase 60-cycle, 2300-volt, Allis-Chalmers turbo-generators with control panels, condenser, boilers, economizers, super-heaters, feed water regulators, pumps, piping, induced-draft fan, direct firing coal pulverizers with bin and stand-by fuel oil burning equipment. All equipment complete with motors and controls where required. In excellent condition and now available.

CONSOLIDATED CEMENT CORP.
111 W. Monroe St. Chicago 3, Ill.

ELECTRICAL EQUIPMENT — REBUILT and GUARANTEED

MOTORS—GENERATORS—MG SETS—TRANSFORMERS—CONTROLS

LARGE STOCK OF A.C. and D.C. MOTORS!

SLIP RING MOTORS—3 Ph., 60 Cy.

Qn.	H.P.	Speed	Volts	Make	Type
6	7½	810	550	G.E.	MTC-5201
1	7½	575	220	G.E.	MT-522
2	10	1149	440	West.	HF-7A
2	10	570	220	G.E.	HI-11
2	11‡	810	550	G.E.	ITC-5008
2	15	1160	440	West.	CW-464C
2	15	570	220	West.	CW-646
1	18	680	440	West.	MW-316
1	20	860	440	West.	CW-638
1	25	1130	550	G.E.	MT-323
2	25	850	220	Wagner	BR
2	25	720	440	Wagner	22VBR
1	30	865	440	West.	CW-646
1	30	850	440	G.E.	MT-332
1	30	675	440	G.E.	MT-336
2	35	600	440	F-M	HV-H16A
2	40	865	2200	Al.-Ch.	ARY-223C
1	40	560	440	G.E.	MT-346
2	50	1150	440	G.E.	M-536
1	50	869	440	West.	HF-12A
5	52‡	550	220	G.E.	IQC-5013***
1	60	685	440	West.	CW-758
1	60	570	550	G.E.	MTC-5546
1	60	345	550	West.	CW
1	75	720	550	G.E.	MT-556
1	80‡	575	440	G.E.	MTC-5352
2	125	430	440	G.E.	IL-16
2	150	1750	440	G.E.	MTP-549
1	175	505	550	West.	CW-1002
2	200	600	550	G.E.	IM-17
1	200	495	2200	G.E.	IM-17A
3	250**	296	220/ 380††	West.	CW-20-53-15
3	300	900	140	G.E.	IM-17
2	300	880	2200	G.E.	IM-17A
1	300	514	550	G.E.	IM-17A
3	300**	360	440	West.	CW-20-53-15
2	350	880	2200	G.E.	IM-17A
1	400	505	550	West.	CW
1	700	720	2300/4000	West.	CW

All 220 volt motors can be reconnected for 440 volts and vice versa.
‡ Intermittent rating. *** 2 phase.
** New. †† 50 Cycle.

230 Volt Constant Speed D. C. Motors

On.	H.P.	Speed	Make	Type
22	2	850	West.	SK-20
20	3	1150	West.	SK-20
10	3	850	Reliance	Y-23T
25	3½	850	West.	SK-30
3	7½	1750/1310	West.	SK-43
2	7½	1150	G.E.	CDM-66
2	7½	875/1750	West.	SK-631
3	7½	850	G.E.	CD-75
10	10**	1750	Kimble	BA-324
5	10**	1150	Al.-Ch.	EB-80
1	10	850	West.	SK-83
10	13½**	600	West.	SK-93
5	15	825	West.	SK-90
1	20	1750/1310	West.	SK-83
2	20	1150	G.E.	RC-30
11	20	750	West.	SK-1101
17	25	825	West.	SK-120
1	30	750	G.E.	RC
1	40	1700	West.	SK-103
1	40	750	G.E.	RC-34
1	50	750	West.	SK-150
1	50	650	G.E.	RC-16
2	60	1750/1310	West.	SK-143
3	75	850	West.	SK-160
1	150	700	Al.-Ch.	
2	200	1150	G.E.	RC-38
1	250	1150	C.W.	CMC-101A

230 VOLT ADJ. SPEED D.C. MOTORS

On.	H.P.	Speed	Make	Type
10	1½/2	500/200	G.E.	CD-65
1	2	225/900	Reliance	78T
1	5	450/1800	G.E.	CD-83
2	6	450/1800	G.E.	RF-9
6	5/7½	600/1800	G.E.	RA-30
1	10	400/1600	Reliance	T-927T
1	12½	280/840	West.	SK-130
10	12½**	600	West.	SK-93
1	15	600/1200	West.	SK-100L
1	20	500/1500	G.E.	RF-11
1	20/25	300/1200	West.	SK-153
1	25	500/1500	G.E.	RF-12
1	23/29	300/1200	G.E.	RF-13
1	30	400/1200	West.	SK-163
1	30/4C**	400/1600	G.E.	CD-1236
1	35	500/1500	West.	SK-143
1	40/50	400/1600	Al.-Ch.	EB-147
1	75	500/1500	Cr.-Wh.	CCM
1	75	375/750	Cr.-Wh.	CMC-125H
3	100	225/900	G.E.	MPC-A
5	100	400/1200	Al.-Ch.	
1	100	320/960	West.	SK-200
1	175	230/750	West.	SK-220
2	375	350/500	G.E.	MPC

** New.

VARIABLE VOLTAGE DRIVES

40 HP. Reliance, Variable Voltage Drives, each Consisting of:
1—40 KW. 250 Volt, Induction M-G Set, with two auxiliary 5 KW generators and exciter.
1—40 HP 400/1500 RPM, Frame 385T, 230 Volt, DC Motor.
With full magnetic control providing jog forward, jog reverse, run, fast, slow, and stop, and motor operated field rheostat.

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.
Totally Enclosed Fan Cooled, Ball Bearing

Qn.	H.P.	RPM	Volts	Make	Type & Frame
2	½	1750	220	R&M (TE)	L-184
1	½	1725	440	G.E.	K-63
4	1	1140	220	Howell	A-204
4	1.5	1150	220	L.A. (TE)	IS-225
5	1.5	1140	440	West.	CS-225
1	2	1735	220	G.E.	K-224
4	2	1140	220	L.A.	JS-225Y
1	2	1100	440	West.	CS-225
1	3	3450	220	Howell	K-224
3	3	1160	440	L.A.	JS-254
1	5	3480	220	G.E.	K-225
2	5	1750	440	L.A.	JA-254
10	5	1730	440	G.E.	K-254
1	5	1720	440	Century	SCH-254
2	5	1165	440	L.A.	JA-284
5	7.5	1740	440	G.E.	K-284
1	7.5	1735	220	G.E.	KF-284
1	10	3480	440	West.	CS-324
1	10	1140	440	Wagner	CP2-326
1	10**	880	220	West.	CS-365-EXPF
1	15	1745	440	West.	CS-326
1	15	1175	440	L.A.	JA-365
1	25	1170	220	L.A.	JX-405
1	25	705	440	West.	CS-W504

Splashproof, Ball Bearing

1	2	1735	440	G.E.	K-224
1	3	1160	440	L.A.	FS-254
23	5	1750	440	L.A.	FS-254
1	5	1735	220	G.E.	K-254
1	5	1160	440	L.A.	FX-284
1	10	3480	440	G.E.	K-284
1	15	1175	440	L.A.	JA-365
4	15	1150	440	L.A.	FX-365
3	30	3520	440	L.A.	FX-365S
3	40	1175	220	G.E.	K-445
3	50	1760	440	L.A.	FX-445A
5	50	1160	220	G.E.	K-504
1	75	870	440	West.	CS-752-C
1	125	1770	440	L.A.	FX-107SY
1	150	1775	440	L.A.	FX-116S
4	150	880	440	L.A.	FX-136S
1	150	700	440	G.E.	K-6335
1	200	885	440	L.A.	FS-137S

Open Type Motors

On.	H.P.	Speed	Volts	Make	Type
5	2	170	440	G.E.	KT-926
4	2	1160	440	West.	CS-93C
1	2	690	440	G.E.	KT-944
10	5	1740	440	West.	CS-232C
1	7½	3475	440	West.	CS
1	7½	1750	440	West.	CS-250C
3	7½	1165	440	G.E.	KT-952
2	7½	870	440	West.	CS-370C
5	10**	1760	440	L.A.	OGA-324
5	10**	1750	440	West.	CSP-324
3	10	1160	440	West.	CS-370C
1	10	865	440	G.E.	KT-502
1	15	3485	220	Reliance	AA-B3247
5	15**	1735	440	Century	SC-326
1	15	1200	220	G.E.	KT-502
1	15	900	220	G.E.	FTR-512
1	20**	3475	220	West.	CS-326
5	20**	1750	440	Wagner	RPI-364
1	20	1750	220	West.	CS-W364
1	20	1200	220	G.E.	KF-512
2	20	900	220	G.E.	FTR-522
1	25	1800	220	G.E.	KT-312
5	25**	1740	440	Century	SC-364
1	25	1160	440	West.	CS-667C
1	25	900	220	Howell	SCRB-356***
2	25	575	440	G.E.	KT-542
1	30	1160	440	West.	CS-644
1	30	870	220	West.	CS-646
1	40**	3545	220	G.E.	KF-404S
3	40	1750	440	West.	CS-583C
2	40	900	2300	G.E.	FTR-536
4	50**	1750	440	Wagner	RP5-405
1	50	850	220	West.	CCL
2	60**	1750	440	Ideal	AH-444
2	60	900	440	G.E.	KT-346
1	75	1160	440	West.	CS-662C
1	75	870	220	West.	CS-766A
1	100	690	220	West.	C
1	100	580	2200	G.E.	IK-15A
2	100	500	2200	West.	CS-930
1	100	495	2200	Al.-Ch.	AN
2	125	435	440	Al.-Ch.	AR
2	125	400	2300	G.E.	1-17-FR
2	200	580	550‡‡	G.E.	KT-566S
1	500	1200	440	G.E.	KTP-567
1	700	1800	2300/4000	West.	CS-4-39D-12

All 220 volt motors can be reconnected for 440 volts and vice versa.
** New. *** 2 Phase.
‡‡ Reconnectable for 440 volts.

CRANE, MILL TYPE 230 V. D.C. MOTORS

On.	H.P.	Speed	Make	Type
2 (115 v.)	3½	700	G.E.	CO-1803
2	5½	760	West.	MCB-20
1 (new)	10	650	G.E.	MD-403-BE
3	25	590	Diehl	TE
2	35	750	G.E.	CO-1828
3 (new)	35	600	West.	CK-9
1	50*	750	G.E.	CO-1829A
1	50	600	West.	CK-9
5 (new)	50	525	G.E.	COM-1830AE
1	59	470	G.E.	CO-2007
2 (new)	60	550	G.E.	COM-1831AE
4	65	450	G.E.	COM-1830

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment Is Located in Our Cleveland Warehouse. We Have Controls for Most Items Listed.

ELECTRIC GENERATOR & MOTOR CO.
4521 HAMILTON AVE. CLEVELAND 14, OHIO

SEARCHLIGHT SECTION

SLIP RING MOTORS
3-Ph., 60 Cy.

HP	Volts	Make	Speed
200	2200/440	G.E.	600
200	2200/440	G.E.	1200
200	440	G.E.	450
150	550	G.E.	720
150	2200/440	G.E.	1200
125	440/220	G.E.	600
125	440/220	G.E. (Hoist)	900
100	2200/550	G.E.	1800
100	440/220	G.E.	720
100	2200/440	G.E.	600
80	440/220	G.E. (MTC)	900
75	2200/550	G.E.	1800
75	2200/550	G.E.	900
50	440/220	G.E.	900

SYNCHRONOUS MOTORS
3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	440/220	G.E.	ATI	600
300	2200/440	G.E.	ATI	600
250	440/220	Whse.	HR	277
200	4150/2300	Whse.	G	1800
150	4150/2300	G	G	1800
120	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	G.E.	TS	900
100	440/220/25 cy	G.E.	TS	375
100	440/220	Whse.	G	1800
75	440/220 (new)	Whse.	G	1800
75	2200/440	Whse.	GE	600

TURBO GENERATOR
Generator, 125 kva. 1200 rpm. 440/220 v., Whse., dir. conn. by reduction gear to Turbine, 100 kw, 7380 rpm. non-condensing, 150-200 lbs. ga. pr. complete with dir. conn. exciter and switchboard; practically new condition, never used.

AIR COMPRESSOR UNIT
1—13" and 8" by 10" Worthington FEATHER-VALVE, 285 rpm, 110 lbs. ga., motor-driven, complete.

CIRCUIT BREAKERS
1—5000 amp., ITE, 3 pole, 600 v., air
1—4000 amp., ITE, 3 pole, 600 v., air
2—2000 amp., G E, 3 pole, 600 v., air
2—1600 amp., ITE, 3 pole, 600 v., air

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
600	2300/440	G.E.	KT	1200
500	440/220	G.E.	IK	900
400	550	G.E.	IK	720
350	2200/440	Whse.	CS	600
300	2200/440	Whse.	CS	600
200	440/220	G.E.	TEFC	1800
200	2200/440	G.E.	KF	720
200	2200/550	Cr. Wh.	SC	900
200	2200/440	G.E.	KT	1200
150	440/220	Howell	B. Brg.	1800
150 vert.	440/220	G.E.	KTP	1200
125 vert.	440/220	G E.	KTP	1200
125	440	G.E.	KT	600
100	440/220	G.E.	KT	450
100	2200/440	G.E.	K	1200
100	2200/550	G.E.	KT	900
75	440	G.E.	KT	600
60	440/220 (new)	L. Allis	OGA	1800

A. C. GENERATORS
1—320 kva., 600 rpm., 440/220 v., G.E.
1—300 kva., 600 rpm., 2200/440 v., G.E.
1—150 kva., 1800 rpm., 2200/550 v., Whse.
1—112 kva., 900 rpm., 440/220 v., G.E.
1— 98 kva., 1800 rpm., 440/220 v., G.E.
2— 75 kva., 1800 rpm., 440/220 v., Whse.
1—62½ kva., 1200 rpm., 440/220 v., Whse.

D. C. MOTORS

HP	Volts	Make	Type	Speed
200	230	Cr. Wh.	CMC	330
150	230 (new)	Cr. Wh.	TEFC	900
100	230	Cr. Wh.	CMC	625
100	230	G.E.	CD	1750
75	230 (new)	Whse.	SK	1150
75	230	Whse.	SK	850
75	230	Whse.	SK	1750

MOTOR GENERATOR SETS
1—250 kw., 250 v., 1200 rpm., Cr. Wh., conn. to 300 kva., 400/2300 v., 3 ph., syn. motor.
1—150 kw., 250 v., 1200 rpm., conn. to 250 hp., 440/220 v., 3 ph., sq. cage Whse. motor.
1—100 kw., 250 v., 900 rpm., Cr. Wh., conn. to 150 hp., 440/220 v., sq. cage.
1—75 kw., 125 v., 1200 rpm., G.E., conn. to 120 hp., 2200/440 v., syn. motor.
1—75 kw., 250 v., 1200 rpm., Whse., conn. to 112 hp., 440/220 v., sq. cage motor.
1—50 kw., 250 1200 rpm., G.E., conn. to 75 hp., 440/220 440/220 v., 60 cy., G.E. syn. motor.
1—50 kw., 250/1200 rpm., G.E., conn. to 75 hp., 440/220 v., 60 cy., syn. motor.

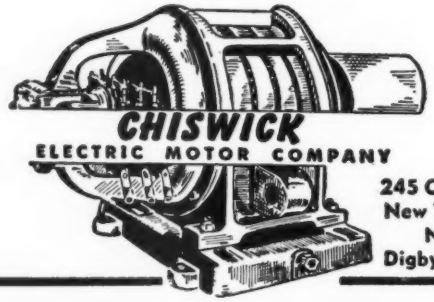
TRANSFOMERS
60 Cycle
1—1000 kva., Al. Chal., 2400-120/240/208 volts, 3 phase. NEW.
1—500 kva., G.E., 2400/4150Y-240 v., 3 ph., unused.
1—400 kva., G.E., 2300-230/115 v.
3—200 kva., Whse., 7200/12400Y-240/480 v., 1 ph.
3—200 kva., G.E. 4800/2400-120/240 v., 1 ph.
1—150 kva., Whse., SK, 13200-125/215 v., 3 ph.
6—100 kva., G.E., 4600/2300-230/115. NEW.
3—100 kva., G.E., 450-115/230 v., dry, 1 ph., new.
3—37½ kva., Whse., 440-115 v., dry, 1 ph.

STEPHEN HALL & CO.
HARRY J. RICE PRES.
458 SEVENTH ST. HOBOKEN, N. J.

MOTORS • CONTROLS • GENERATORS

Rebuilt Guaranteed Equipment in Stock

SIZES FROM 1 HP TO 250 HP



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2—2100 HP, GE Synchronous motors, 514 RPM, 4600/2300 V, 3 phase, 60 cycle, 80% P.F. Complete with rheostats and belted exciters. Full details on application.
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1—500 KW Whse reduction gear turbo-generator unit, type 6 EHNC, non-condensing, compound interpole, good commutator 125/250 V.
1—750 KW Whse generator only, single bearing. 550 RPM, compound interpole. 125/250 V. Splendid condition.

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150 KVA Westinghouse Alternator, 2300V/60/3; 200 r.p.m. direct connected to Skinner Automatic Steam Engine, 23"x18", 125 lbs. pressure.
125 KVA General Electric Turbo-Generator Unit, 480/60/3; 3600 r.p.m., 150 lbs. pressure, condensing type, with direct connected exciter.
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8—General Motors MOD 3-268A—150 HP, direct connected to Westinghouse 100 KW—3 PH—60 CY—480 Volt—1200 RPM Generators with direct connected Exciters.

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1—750 KW Gen. Elec. 3 Ph., 60 Cy., 440 Volts, Dir, Conn. Exciter Surface Condenser Built 1944.

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1—500 KW G.E. 480v, 3 ph., 60 cy. dir. conn. exciter with 80/100 lbs. I.S.P., 10/15 lbs. B.P., non-condensing turbine

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125 KVA GE 240/480 v. —Moore 250#.
115 KVA Wghse. 2400/480 v.—Sturtevant.
62.5 KVA GE 240/480 v.—DeLaval.
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3500 sq. ft. Wheeler.

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375 KVA FM "32E-14"; 480/240 v.
200 KVA Fairbanks Morse "VA" 2300 v.
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507 HP Combustion 400#.
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469 HP Sterling 425#.
404 HP Springfield 375#.
312 HP Stirling 180#.
288 288 HP Combustion HRT 150#.
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106 HP Locomotive Type 250#.

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750 KVA GE 480/240 v.—Skinner Ver. Unif.
688 KVA Al. Chal. 600 v.—Al. Chal. Corliss.
312 KVA GE 2300/480 v.—Chuse 4 v.
187 KVA GE 480/240 v.—Chuse 4 v.
187 KVA Wghse. 240/480 v.—Ames Ver. Unif.
187 KVA GE 2300 v.—Chuse 4 v.
166 KVA Al. Chal. 480/240 v.—Ames Unif.
79 KVA Al.Cham. 480/240 v.—Ames Unif.

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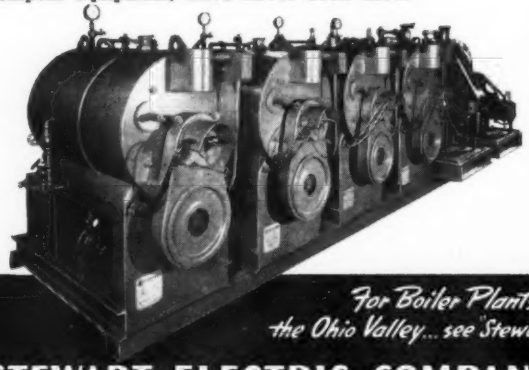

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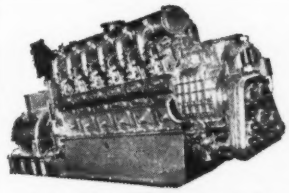

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Westgh. 250V, 900 rev. cpd. Interpole gen. 714 HP 8 PF 2300/4000V, 3 p. 60 cyc. syn. with AC & DC panels.

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Power Plants, steam-electric, 1500 to 3000 KW.
125 HP portable power boiler, oil fired.
Fairbanks-Morse Diesel engine, 575 HP, 1944.
Plymouth 10-ton gas locomotive, 36" gauge.
Steam locos., 17 to 52 tons, various gauges.
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1—187.5 KVA Westinghouse 240 V. Noncondensing

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1—156 KVA Ames Vertical Unaflow 240 V.

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General Motors, Fairbanks, Nordberg, and Buda, from 15 to 1000 KW. New and Rebuilt.

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2—New 1000 G.P.M. 180' head, 1760 RPM Gardner Denver Centrifugal Pumps—Solid Bronze Construction; can furnish motors or Diesel Engine drives.
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1	75	1200	Wstg.	Open SB
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1	150	250	G.E.
1	125	250	Wstg.
1	100	250	Al. Ch.
2	75	250	C. W.-Al. Ch.
1	60	125	Reliance
2	50	250	G.E.-Al. Ch.
10	3	250	Rel.-G.E.

Reconditioned & Guaranteed
D. C. ADJUSTABLE SPEED MOTORS,
230 volts

4	15/20	400/1200	G.E.	RLC-203A, Shunt
1	15, 20	600/1800	Rel.	131-T
1	20/25	400/1200	E.D.	
7	20/25	600/2000	G.D.	CD-105
1	25/30	500/1500	Rel.	Shunt
1	30/40	400/1200	G.E.	RLC-204
3	40	250/1500	G.E.	CD-1441
1	40/50	350/1050	Wstg.	SK
1	50/60	300/900	E.D.	Frame 30-S
1	135/175	450/1200	G.E.	
1	150	262/750	G.E.	MPC, Shunt
1	200	300/900	Wstg.	

Also many other sizes and types, too numerous to list. Send for our latest stock list.

SPECIALS!

1—3000 amp., 3/40 volt Electric Products anodizing M-G Set.
6—New 7½ HP, 600 RPM Wstg 230 volt DC totally enclosed motors.
2—New 50 HP 600 RPM G.E. 230 volt DC totally enclosed motors.
1—50/60 HP Electro Dynamic 300/900 RPM 230 volt DC motor.
3—Reliance 40 VS Drives with 40/50 HP 400/1600 RPM DC motor and complete AC and DC controls.
5—Reliance 10-VS Drives with 7½/10 HP, 400/1600 RPM D.C. Motors.

CONTROLS

8—New Cutler-Hammer 5000 volt magnetic oil contactors—to 1000 HP.
50—New 3 HP 115 volt DC G.E. Marine Type Starters.
1—New 30 HP 230 volt DC Cutler-Hammer Fire Pump Control.
10—125 HP 440/3/60 Cutler-Hammer fully magnetic reduced voltage controllers.
5—New 125 HP, 440/3/60 fully magnetic Allis-Chalmers Slipring Controllers.
50—New Cutler-Hammer Compensators, 50 to 150 HP, 220 and 440 volts.

MISCELLANEOUS

27 New Harnischfeger Electric Hoists 500 & 1000 lbs., 220-440-550 volts.
5—New Ingersoll Air Compressors, 1½—3—5 HP.
1—Hill-Acme 3000-lb. Capacity Portable Goose-Neck Crane.
2—25 KVA G.E. Transformers, 2300 v. primary, 230/460 secondary, 3 phase.

The A-C SUPPLY co.
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Plant & Office
Cuyahoga Falls, O.
Telephone (Akron)
WAlbridge 1174

FOR SALE — SEALED BIDS

The City of Fort Pierre offers the following equipment for sale.
Sealed Bids:

1—Bessemer Oil Engine, Type 1V 2 cylinder 100 H.P. 257 R.P.M.
1—Westinghouse Generator 80 KVA 257 R.P.M. 2400 volts 60 cycles 3 phase.
1—Westinghouse Exciter 6½ K.W. 125 volts, 52 amps, 1450 R.P.M.

Each to be sold separately less all valves, fittings and piping. Above equipment to be completely removed from power plant within 30 days after bid has been accepted.

Bid to be received until the 7th day of September 1948 at 8 o'clock P.M. Central Standard Time at the city council room in Fort Pierre, S. Dak.

The city council reserves the right to reject any or all bids.

EARL FACKELMAN
City Auditor

POWER PLANT EQUIPMENT

Special Offerings

TURBO-GENERATORS

1—3500 KW 2300 V. Cond
1—3000 KW 600 V. Cond
2—2500 KW 440 V. Cond
1—2500 KW 2300 V. Cond
1—2000 KW 600 V. Cond
1—1500 KW 2300 V. Cond
1—1500 KW 600 V. DC Cond
2—1250 KW 2300 V. Cond
2—1000 KW 480 V. Extrac.
1—1000 KW 2400 V. Cond
1— 750 KW 2300 V. Cond
1— 600 KW 240 V. Cond
1— 500 KW 600 V. DC Cond
1— 500 KW 480 V. Cond
1— 500 KW 480 V. Extrac.
1— 250 KW 2300 V. Cond
1— 150 KW 2400 V. N. C.
2— 125 KW 220 V. N. C.
1— 125 KW 600 V. Extrac.
1— 50 KW 220 V. N. C.

BOILERS

1—150,000# 450# New
1— 30,000# 400#
1— 30,000# 425#
1—1030 HP 225#
4— 500 HP 200#
2— 500 HP 175#
2— 500 HP 400#
2— 480 HP 225#
2— 400 HP 180#
1— 400 HP 200#
1— 300 HP 200#
2— 250 HP 160#
1— 175 HP 15#
3— 158 HP 150#

TRANSFORMERS

3—667 KVA —2300/460
3—500 KVA 11,000/460
3—500 KVA 13,800/575
3—200 KVA 600/220/110

ENGINE-GENERATORS

1—375 KW 2300 V. Uniflow
1—168 KW 600 V.
1—168 KW 220 V. Uniflow
1—150 KW 240 V.
1— 75 KW 240 V. Uniflow

AIR COMPRESSORS

1—6000 CFM 50# Motor
2—5600 CFM 50# Motor
1—1200 CFM 100# Motor
1— 700 CFM 100# Motor
1— 400 CFM 100# Steam
1—6000 CFM 5.1# New
1—5000 CFM 10# Rotor Type Syn. Motor 440 V.

BELTED GENERATORS

1—520 KW 360 RPM 550 V.
3—500 KW 225 RPM 550 V.
1—350 KW 300 RPM 550 V.
1—180 KW 600 RPM 550 V.

Write or wire for additional data and prints.

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The Buyers Must Be Satisfied—Always

DIESEL-GENERATORS

5 KW. TO 1000 KW.
NEW-USED
RECONDITIONED
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MURRAY HILL 7-6547

4000 K.W. NEW 600# 125# bleed, 25# B.P. NC turbo set.
1500 K.W. used 175# and 25# B.P. NC turbo set.
30x42 Allis tailrod heavy duty corliss rolling mill engine.
Send lists for sale and inquiries for all power units.

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FOR SALE

Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

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Jackson, Miss.

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DIESEL ENGINES DIESEL GENERATORS
TURBO GENERATORS

WE HAVE ON HAND ONE OF THE LARGEST INVENTORIES OF POWER EQUIPMENT IN THE EAST . . . . . .

MOTOR GENERATORS - STEAM ENG. GENERATORS - CENTRIFUGAL FANS - CENTRIFUGAL PUMPS - ROTARY PUMPS - RECIPROCATING PUMPS - MACHINE TOOLS - MOTORS A-C D-C - AIR COMPRESSORS

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One Westinghouse non-condensing turbo-generator unit complete with direct connected exciter, serial No. 8135684, designed for 400 psi steam pressure, 780 KVA, 3 phase, 60 cycle, 2400 volt and 3600 rpm, with accessories, including auxiliary oil pump, switchgear, field rheostat, oil cooler and meters. The turbine steam chest and throttle valve are designed for 400 psi and 700 F; the nozzles, valve fittings and blading for 125 psi. Good operating condition. Discontinuing because of change over to public utility service. "As is" and "where is" basis. Apply

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One 125 H. P. Cyclotherm steam generator built for 125# steam working pressure and arranged for operation with No. 6 oil, Gas ignition with 220 volt 60 cycle, 3 phase alternating current.

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FOR SALE

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ALSO ALL TYPES OF AIR COOLED AND PHASE CHANGERS.

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STEAM ENGINE GENERATORS

1—Harrisburg Foundry & Machine 22 x 28 operating 150# steam 5# B.P.
1—Erie Ball Engine Co. 22 x 30 operating 150# steam 5# B.P.
Each direct connected to General Electric D.C. Generators Type LD-12, 300KW, 240V, 2 wire, 35°C Rise.
Both in excellent running condition complete with switchboard.

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75 HP, 1,800 RPM, U. S., 220/440/3/60, Ind.
65 HP, 1,200 RPM, G.E., 220/440/3/60, Ind.
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5, 7½, 10 and 15 HP, new and used, TEFC and open.

(5) 5 HP, 2,200 RPM, Reliance, Ex. Pr., 230 V. DC.
Several Whse. type SK, 230 V, DC.

GENERATORS

100 KW, 1,400 RPM, Whse. SK, 250 V. DC.
100 KW, 2,000 RPM, Whse. SK, 250 V. DC.

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One G. E. 1000 KW, 3600 RPM, 150# S P condensing Curtis *Steam Turbine* complete with generator, exciter, condenser and pumps.
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NEW-USED
RECONDITIONED

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1—60 KVA 3-6-240 Fairbanks-Morse belt type generator with exciter and panel.
1—40 KVA 3-6-240 Fairbanks-Morse belt type generator with exciter and panel.
1—12,000 gallon fuel tank.
1—Fairbanks-Morse centrifugal pump with 10 H.P. motor.
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1—18"x36" horizontal Corliss Steam Engine, with 12' dia. x 14" face flywheel and oiling devices — outboard bearings — belted fly ball governor direct connected to G.E. a.c., shaft mounted Generator #75481 — Type ATB, Class #24-200B-125 —Form E—125 r.p.m.—600 volts, 193 amps.

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from ¼ HP to 300 HP

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INGERSOLL RAND

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Direct connected to

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1— 250 Lbs.

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for Immediate Delivery

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1—DC General Electric Motor 35-50 HP, 115V, 260-375 Amps, Shunt.

FS-6086, Power
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Complete With Switchboard, Control Panels, Etc.
SLIGHTLY USED—EXCELLENT CONDITION

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CO lonial 5139

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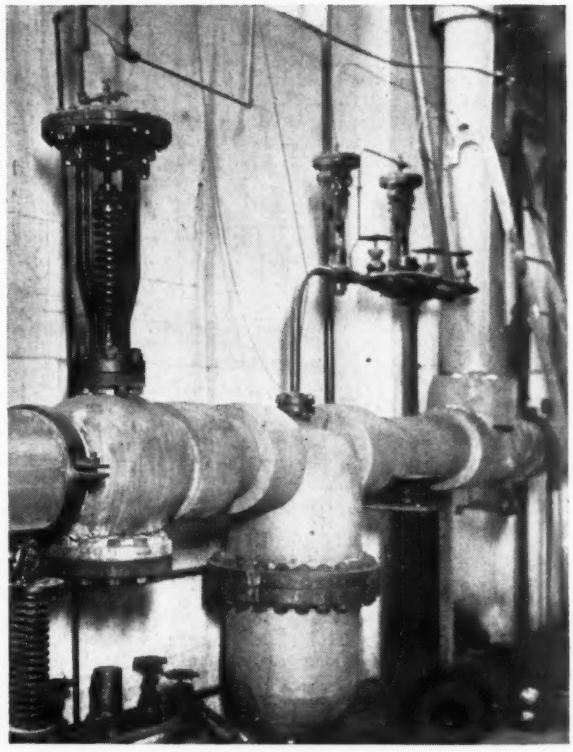

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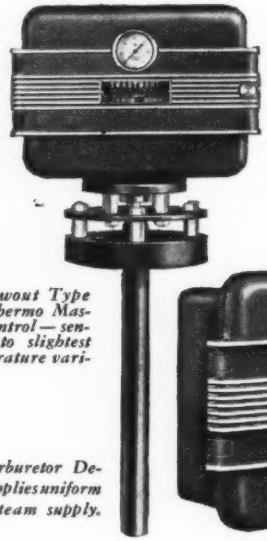

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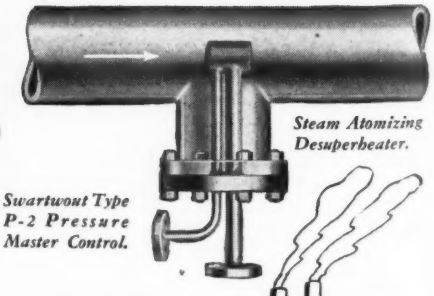

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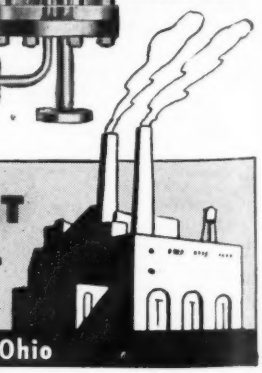

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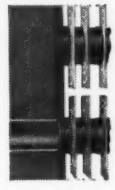

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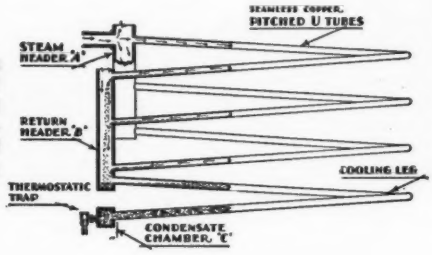

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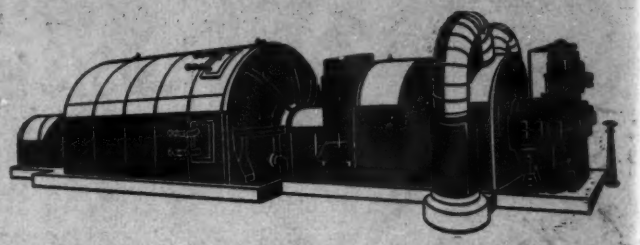

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